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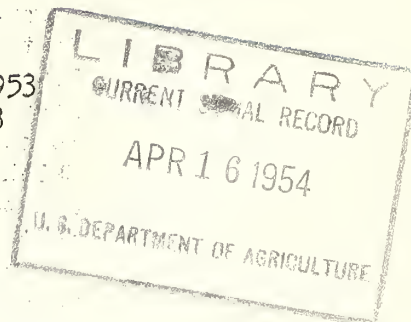
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Report of the
TENTH SOUTHERN PASTURE AND FORAGE CROP
IMPROVEMENT CONFERENCE 1/

Agricultural Experiment Station
of the
Virginia Polytechnic Institute

Blacksburg, Virginia, June 11-12, 1953
Middleburg, Virginia, June 13, 1953

Thursday, June 11, 1953.



8:30 A.M. Registration - Lobby, New Smyth Hall

R. C. Potts, Conference Chairman

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8:30 A.M. Registration - Lobby, New Smyth Hall.

R. C. Potts, Conference Chairman,
Texas Agricultural Experiment Station.

Those attending the conference registered at the desk in the lobby of New Smyth Hall the evening of June 10 or early the morning of June 11. A total of 105 members registered for this 10th Conference. A list of those in attendance is attached.

The members assembled in the auditorium of New Smyth Hall for the opening session. Dr. R. C. Potts, Conference Chairman, Texas Agricultural Experiment Station, called the Conference to order at 8:45 A.M. Dr. R. E. Blaser of the host institution was asked to introduce the speakers from Virginia. The Conference proceeded as planned.

8:45 A.M. Welcome to Visitors - Walter S. Newman, President, Virginia Polytechnic Institute.

President Newman extended a hearty welcome to the group and reviewed the past history of the Virginia Polytechnic Institute. The difference in type and kinds of farming systems over the state has resulted in a wide diversity of agricultural problems. President Newman called attention to the number of branch agricultural and engineering schools over the state. He pointed out that real progress is being made in forage research due to team work in fields concerned. He expressed the opinion that the coming of the group to Virginia would be a real inspiration to the Virginia research staff.

9:00 A.M. Introduction of Members, by States.

One of more representatives were present from each of 13 states, a delegation from Maryland and from various branches of the Department of Agriculture and from industry.

9:15 A.M. The Importance of Interdepartmental Cooperation in Livestock-
Forage Programs - L. B. Dietrick, Dean of Agriculture, Va.
Polytechnic Inst.

Dean Dietrick pointed out that cooperation applies not only to a livestock program but to any program up for development. It is essentially working together for a common purpose. Cooperation is an attitude which results in working unselfishly together right through to the ultimate solution of the problem concerned.

According to Dean Dietrick, departments have become specialists; in fact, they have had to specialize. On broad problems, no one department would have all the answers. This has resulted in the necessity of pooling information to get at the answers. There are many examples of cooperative efforts. The Animal Husbandry Department is evaluating various forages for silage. Answers to questions as to forage varieties and fertilization practices necessary for proper growth are needed from the agronomists as well as other cultural methods. In Dairy Research, the dairy nutritionists need the assistance of the agronomists and the animal and plant pathologists to conduct a thorough evaluation of certain forages as dairy feed. Dean Dietrick called attention to a silage bulletin by the Agronomy Department of the Virginia Polytechnic Institute. The bulletin was developed in conference with the Departments of Animal and Dairy Husbandry, Agricultural Engineering and Agricultural Economics.

In closing, Dean Dietrick stated that cooperation must continue on through to getting the information to the farmers. Good cooperation is not possible for a selfish purpose. Cooperative advancement can go only as far as the units involved are concerned.

9:30 A.M. The Importance of a Forage Crops Research Program - E. N. Young,
Director, Va. Agric. Expt. Station.

According to Director Young, the importance of forage crops research is appreciated when we realize that livestock production is highly competitive. It is animal production under a system of unlimited competition. Fluid milk is usually produced under limited competition. The systems or areas of livestock production have been changed the past 15 to 20 years. Formerly there were two major livestock producing areas, the range country and the corn belt. In the range country large acreages were available per animal unit capable of producing feeder stock, essentially the skin and bones, for the corn belt or cheap grain country. Most of the finished beef, hogs, butter and cheese was then produced in the corn belt. The feed recommendations were based largely on cheap grain and such grains were necessary in standard quantities for the production of these animal units.

Increased livestock production in the South is changing this picture. Livestock production in this area, as is true over much of the South, is the result of the development and utilization of our natural resources. Much of our land is better adapted to pasture and hay than for any other crops. According to Director Young, the real job of research is to continue to develop this great ^{natural} reservoir in this country. The beef industry must be so developed that meats of unquestionable quality can be produced on a highly competitive basis.

Director Young continued by saying that we must learn to produce a cheap supply of pasture and forage as well as a high quality of forage. With the establishment of good pastures and forage crops must come the development of a livestock economy. A shift from a grain crop philosophy to a forage crops philosophy is in order. Such a shift involves teamwork from practically all agricultural fields.

Director Young concluded by saying that the establishment of a livestock economy in the Southeast would mean a more stable civilization and result in the utilization of our natural resources on a sound basis.

9:45 A.M. A Coordinated Agronomy Research Program - H. L. Dunton, Head,
Dept. of Agronomy, Va. Agric. Expt. Station.

Dr. Dunton called attention to the fact that Virginia is in between northern and southern latitudes with respect to climate and soil types. The situation greatly increases the cropping problems of the state. Field research work is carried on at 10 branch stations over the state. All projects under way at the field stations are approved or developed at the main station.

According to Dr. Dunton, the type of agriculture varies from the peanut-corn-hog area in the coastal plain of the Southeast to the all-bluegrass and hay area west of the mountains where but little land is in cultivation. In between is the bright tobacco area of southern Virginia where 85% of the income is from 10% of the land. In the central and north-central coastal plain the economy of the area is not tied to any particular commodity or crop. In general, in these areas, livestock production is increasing. The North Piedmont is essentially a dairy and beef cattle area and of country estates. The mountainous area of northern Virginia is the apple producing section of the state. Livestock production is also important in this area. From the Shenandoah Valley south and west, livestock production is the important farm enterprise. Poultry production is increasing, particularly in the Shenandoah Valley. Dr. Dunton concluded by saying that livestock production should and is being increased in the Piedmont and upper coastal plain of central and southern Virginia.

10:00 A.M. Intermission.

10:15 A.M. The Regional Pasture Management Project - E. H. Fergus,
Kv. Agric. Expt. Station.

Dr. Fergus reviewed the history and development of the Southern Regional Pasture and Forage Crops Technical Committee. The overall objective of the Technical Committee is to develop and coordinate pasture and forage crops research on a regional basis. Each of the southern states has a member on the committee appointed by the Director of the Experiment Station. In order that all know who the members of the Technical Committee are, Dr. Fergus called the roll of the Committee and asked that each man stand. The Committee is as follows:

Alabama	F. D. Donnelly
Arkansas	P. C. Sandall
Florida	G. E. Killinger
Georgia	O. E. Sell
Kentucky	E. N. Fergus, Chairman
Louisiana	C. R. Owen
Mississippi	H. W. Bennett
North Carolina	D. S. Chamblee
Oklahoma	J. R. Harlan
Puerto Rico	E. Boneta-Garcia
South Carolina	R. J. Metzger
Tennessee	J. K. Leasure, Secretary
Texas	R. C. Potts
Virginia	R. E. Blaser
USDA, Plt. Indus. Sta.	D. F. Beard
" Office Expt. Sta.	Nolan E. Farris
Advisor	R. W. Cummings, N. Car.

Dr. Fergus reported that in the beginning the Technical Committee, with the assistance of other technical workers in the region, prepared a pasture project directly concerned with the improvement of forage crops in the South. This project, known as S-12, was submitted to the Southern Experiment Station Directors and was finally approved by the Committee of Nine and the Office of Experiment Stations, USDA. The overall project covered a great diversity of plants, of methods and techniques, and environmental factors. The southern Directors felt that the project was too general. As a result, the Technical Committee discussed more specific lines of work and arranged these specific lines by priority. The lines of investigation in order of priority are as follows:

1. Techniques for measuring pastures.
2. Breeding and fundamental information.
3. Physiological studies.
4. Seed production.

At Baton Rouge, La., last year the Technical Committee drew up a specific project in techniques for measuring pastures. This project was further amended at the meeting just ended here. The final form is being submitted to the southern directors. This present subproject is subdivided as follows:

- 1a. Examine techniques which have and are being used in pasture evaluation.
- 1b. Study of new techniques, indicator methods for evaluating forages.

Dr. Fergus stated that Dr. Cummings is hopeful that funds can be obtained to initiate these studies in the next fiscal year.

11:45 A.M. The Conference adjourned for lunch.

1:15 P.M. New Forage Crops Research Findings and Developments in the Southeast - R. C. Potts, Chairman.

Dr. Fotts called the Conference to order. One or more representatives from each Agricultural Experiment Station reviewed the forage crops work under way, particularly new developments in their respective programs. These are given by states, as follows:

Alabama: E. D. Donnelly, reporting.

The Alabama Station has no new forage crop variety for release at this time. However, the Auburn strain of woolypod vetch, which was selected by H. R. Albrecht, has performed well in the Regional Uniform Winter Cover Crops Tests for several years. Information is now needed as to the ability of this vetch to produce seed in the West before the advisability of submitting this vetch for increase as a new variety can be determined.

In the past it has been observed that different seed lots of white clover bearing the same designation performed considerably different one from the other. In an effort to study the amount of such variation, P.M.A., cooperating with certain State Seed Laboratories and Experiment Stations, has tested 100 seed lots of Ladino and intermediate type white clover. These seed were collected in several states. Fifty of these lots were labeled Ladino. With two exceptions these performed as true Ladino under Alabama conditions. Thirty-seven of these were of the intermediate type from one state and had the same designation. Great variation in amount of forage produced was observed among these lots of seed. A need for a reliable intermediate type white clover seed producing program was strongly indicated.

The results of a preliminary grazing test conducted on a spaced-plant nursery indicated that cattle prefer leafy sericea plants with fine, pliable stems and a low tannin content. On the basis of these data, our criteria for selection have been changed accordingly.

The results of three years' work with sericea have not shown that the tannin content of sericea was appreciably affected by additions of lime, phosphorus or potassium except where these elements were deficient to the point that sericea growth was very subnormal. Sericea grown in the greenhouse on a very potassium-deficient soil was severely stunted, chlorotic and considerably higher in tannin than when sufficient potash was added to produce good growth.

From the work to date it would appear that fertilizers and lime do not appreciably affect the tannin content of sericea when applied in amounts above those required to produce good, healthy plants.

Recent annual winter grass tests have shown that rescuegrass, Bromus cartharticus, was superior to common ryegrass, Phalaris minor, and oats in yields of dry forage. Insufficient trials have been conducted to determine differences in strains of rescue.

Studies to determine the value of applying nitrogen to permanent pastures have indicated that the responses to nitrogen are almost directly proportional to the percentage of clover that remains vegetative in the mixture throughout the year. Under irrigation, no increases in yield were obtained from applications up to 128 pounds of nitrogen per acre when the legume population remained high in a white clover, Bermuda-grass, native summer grass pasture. Applications of nitrogen to sods containing little or no clover gave marked increases in yield of forage.

Spring applications of nitrogen to small grains and fescue were more effective in increasing seed yields than fall applications. The yield of seed is almost directly proportional to the amount of nitrogen applied in the spring up to 64 pounds of nitrogen per acre.

Florida: G. B. Killinger, reporting.

New research findings in the forage and pasture research for Florida are quite varied.

For example, E. M. Hodges, D. W. Jones, and W. G. Kirk of the Range Cattle Station near Ona, Florida, report success with irrigation since our last report in 1950. These researchers report on a three-year average (1950-51 and 52), 294 pounds of beef per acre from non-irrigated clover-grass pastures and 810 pounds of beef per acre from irrigated clover-grass pastures. Water applied per season was 16.5, 14.0 and 10.0 inches, respectively.

Dr. R. J. Allen, W. C. Hayslip and J. F. Darby of our Everglades Experiment Station, Belle Glade, Florida, report favorably on a preliminary three-year vegetable-pasture rotation trial, the third year of which is just being completed. Tomatoes, corn and clover-Pangolagrass were the crops in rotation. These researchers feel in actual practice possibly two years in vegetables followed by three to five years in pasture and back to vegetables may be the program. More fundamental data is needed, particularly with regard to diseases and insects following this program.

At the West Florida Experiment Station near Jay, W. R. Langford reports high production of beef and forage from Pensacola Bahia, Coastal bermuda and fescue grasses in conjunction with Ladino clover on the red to brown soils found in that area.

The Main Station at Gainesville, Florida, reports some progress on Big trefoil breeding by Dr. A. T. Wallace, and on white and red clovers by Dr. Earl Horner. The uniform white clover nursery conducted at Gainesville during the past two seasons shows Breeders Ladino and Ladino and Louisiana white clover to be the highest yielding in forage with New Zealand clover giving the least yield. On a one-year basis, 1952-53, Ladino clover from Central California has given more bloom and seed set than Ladino from other locations. Still, on a one-year basis red clover from Port Gibson, Mississippi, has outyielded Kenland red and other red clovers and has about the same susceptibility to mildew. A large-scale cow-calf grazing experiment involving eight different pasture programs, was started near Gainesville, Florida, in the fall of 1952. Agronomy, Animal Husbandry, Soils, Agricultural Engineering and Agricultural

Economics are all cooperating in this experiment. At this time it is too early to report definite results, except that clover-grass combination programs at medium and high levels of fertilization look best.

Alfalfa(Peruvian) has been successfully and profitably produced at Gainesville during the past six years.

Florama sweet clover was released to Florida growers in the fall of 1951.

Georgia. Experiment: O. E. Sell, reporting.

A new grazing experiment at the Mountain Station is planned to determine the relative value for milk production of three major adapted grasses (tall fescue, orchard and smooth brome) with and without Ladino clover. In addition, Orien Brooks is conducting an experiment with various grasses with and without clovers and receiving various rates of nitrogen top-dressing. Coastal bermuda looks surprisingly productive for that far north.

Dr. F. P. Gardner at the College of Agriculture at Athens, is conducting numerous forage species and mixtures tests on the major soil types at three new branch experiment stations.

Various classes of livestock are used by the Animal Industry Department in evaluating forages with new techniques such as:

- a. Forage digestibility.
- b. Daily forage intake by the animals.
- c. Grazing habit studies using particularly ruminating to grazing time ratios.

Relationships of such information and chemical analysis of the forages with animal performance are developed and promise a more basic understanding of forage characteristics as they relate to livestock production.

One item of interest to those who have calculated pasture production in terms of T.D.N. based on livestock performance and average requirements for nutrients follows. Using the indicator and chromic oxide technique of Reid, a group of beef cows was found to consume 48 pounds of dry pasture herbage daily with a digestibility of 72 percent, giving a daily intake of approximately 34 pounds T.D.N. These 1100-pound cows were giving 14 pounds of milk daily and gained about 2 pounds daily in weight. Using animal T.D.N. requirement figures, these cows were supposedly obtaining approximately 20 pounds T.D.N. daily from the pasture. The new techniques in this instance show that pasture production can be seriously and inaccurately underestimated by using the animal requirement method. This should not be interpreted to mean that the latter method is not valid under many conditions; it is only pointed out that the method can be very erroneous under some conditions.

Dr. L. V. Crowder reported that certain brome grass selections look good at the Mountain Experiment Station at Blairsville, Georgia. Tall fescue breeding is being continued at Experiment, Georgia. Ten thousand spaced plants were grazed and checked for palatability as evidenced by degrees of grazing. There was no correlation between leaf width of tall fescue clones and palatability. In a palatability study with sericea lespedeza, animals were found to select plants low in tannin. Low tannin plants generally lacked vigor. White clover breeding is being conducted in cooperation with the Alabama Station. Studies of Lolium-Festuca hybrids are being continued and doubling to secure fertility is being tried.

Georgia, Tifton: G. W. Burton, reporting.

Dr. G. W. Burton reported that they had found significant differences in root development between the grasses. Coastal Bermuda roots were penetrating the sandy soil to greater depths than Common Bermuda, although the latter produced a greater quantity of roots. Cal Verde alfalfa appears promising in tests. Maximum herbage yields from grass-clover mixtures were secured from applications of 50 pounds of nitrogen. Higher rates of nitrogen up to 200 pounds per acre did not increase yields.

Arkansas: P. C. Sandal, reporting.

Breeding work is being stressed on annual lespedeza, alfalfa, orchard grass and tall fescue. Uniform testing of several grasses and legumes revealed in 1952 that sweet clover excelled all legumes in surviving and growing during the extended summer drought. Pasture results from orchard, fescue and Bermuda mixtures indicated the exceptional qualities of Bermuda pastures during extended dry periods.

New pasture work started involves the comparison of Bermuda pastures fertilized with superphosphate and rock phosphate, methods of killing trees on rolling land and the determination of the forage species which will come in naturally as well as results from seeding and fertilizing after tree killing, and the response of Bermuda pastures to varying rates of nitrogen fertilization.

Kentucky: E. N. Fergus, reporting.

Dr. E. N. Fergus reported that Kentucky is stressing the importance of certified seed to farmers. Adapted varieties are designated and efforts are being made to discourage the use of uncertified seed. The breeding program to improve the palatability of tall fescue is being continued. Studies of Lolium-Festuca hybrids are promising since some success has been made in doubling crossed plants. Clones treated with double strength colchicine resulted in fertile pollen formation. Studies are being continued to increase the disease resistance of Kenland red clover. The disease Sclerotinia batoticta is causing serious losses in some fields. Dr. Henson inoculated a large number of plants in the greenhouse in a search for resistance to this disease, but the disease became critical and killed all of the plants. Weakened plants are more susceptible to the disease. Some evidence indicated that grasshopper injury weakened the plants, resulting in a serious epidemic of S. batoticta in certain fields.

Louisiana: C. R. Owen, reporting.

Research with pasture and forage crops in Louisiana includes crop breeding, strain evaluation and management problems with pastures utilized by beef herds. Breeding programs are under way with Dallis grass, white clover, red clover and annual lespedeza. Strain evaluation experiments are inclusive of uniform regional tests as well as certain phases of the crop breeding techniques.

During the past three years certain developments have occurred which were under way earlier. Among them are the release of two new strains of Dallis grass, a synthetic variety of white clover and a new strain of red clover. Each of these were developed from breeding stocks collected in Louisiana. An attempt is being made to increase seed stocks of each of these new strains. Seed production with white clover is more successful at this time than either of the others. Presently about 1000 acres are planted to Louisiana Sl for seed production purposes. In most areas of the state fair prospects for seed crops are reported.

A study of the types of reproduction is the more recent approach to research on the problem of seed setting with Dallis grass. Breeding behavior is observed among progenies in the field and this is checked with the parent clone. It is expected that this work will be supplemented with cytological investigation with certain of the variant types isolated.

Additional work is being conducted with white clover breeding. New clones are under test which originated from plant selection within space-planted nurseries from poly- and single-cross seed. The seed were from clones used in the formation of the synthetic variety. New combinations of clonal lines are being made and tested as the program progresses.

The work with annual lespedeza has been delayed. The delay is considered as due to the apparent lack of resistance to the diseases and insects which are prevalent in the Baton Rouge area.

Comparative forage yield tests have been conducted with strains of about 15 species. This includes both winter and summer grasses and legumes. This work has been extended to include association studies with grasses and legumes. Special study is being given the mixtures of grasses with white clover. Grass mixtures are also being planted with other clover species.

Recent revision of the work with beef cattle production on pastures has stressed the grass-clover association and its effect. The effect of fertilization practices is also being included in this study.

Mississippi: H. W. Bennett, reporting

Seed production and methods of seed harvest have been the object of much research in Mississippi.

Dates and rates of seeding for seed production have shown that: Fall crops (crimson clover, ryegrass, etc.) should be seeded early (August) to late (November) from north to south in the state; spring or summer crops should be seeded early (March) to late (June) from south to north in the state; and most of the forage and pasture crops grown for seed should be seeded at one-fourth to one-tenth the rate used for forage or pasture production.

Methods of seed harvest have shown the value of windrowing. Such a method has resulted in one to three times the amount of seed as compared to direct combining.

Factors affecting seed production studies have given much valuable information. Dallis grass should be harvested some three weeks before commonly practiced. Fourteen days after flowering the seed begin to shatter. These seed are in green glumes and those shattered contained 95% seed. Field scale methods of harvest using new and adapted machinery will be used in 1953. These methods will use the shaking principle.

The seed processing laboratory has been working on machinery arrangement, rate of seed flow, limits of seed viability and such problems. An annual seed processing school is conducted. There were representatives from 20 states in the 1953 school.

Breeders Climax lespedeza seed is being produced by the Mississippi Station. Some 250 pounds were produced in 1952.

Irrigation tests have shown that properly fertilized and irrigated pastures produce 4-6 times the yields of fertilized pastures without irrigation. Sudan grass and millet appear to be valuable crops responding to irrigation and used for intensive grazing.

The Delta Station and the Animal Husbandry Department are conducting bloat studies. They have found that in an animal population there are approximately 1/3 chronic bloaters, 1/3 intermediate bloaters and 1/3 more or less resistant to bloat. Bloating may take place at any time. The most efficient preventive is 40 to 60 percent grass in the mixture.

The Dairy and Animal Husbandry Departments, in cooperation with the Forage Crops personnel, are conducting tests pointing to grazing systems. A Dallis grass-clover permanent pasture has been shown to provide 85 percent of the T.D.N. needed for a milking cow.

North Carolina: D. S. Chamblee, reporting.

Dr. Chamblee reported on the four divisions of work under way as follows:

I. Adaptation, Management and Physiology.

Adaptation:

In tests of various white strains, La. Improved, La. Synthetic #1, AlaLu, all of these strains recovered very poorly following drought, compared with Ladino. Ladino was 2 to 4 times as productive as the white clover strains.

Several strains of orchard grass, tested as part of the Regional test, including Wash. Hybrid 2, Wash. Str. 88, Oregon 233, matured seed approximately one month later and produced much less seed heads than commercial orchard grass.

The millet hybrids B, C, D and E, show promise as being much superior to Common or Starr millet.

The Italian strain of birdsfoot trefoil merits further testing on sandy soils which are not well adapted to Ladino clover.

Management:

Extra fall defoliations of alfalfa after September cause reductions in yield the following season, at least equal to the extra amount of forage obtained by late fall cuttings. No loss of stand, however, has resulted from late fall cutting of alfalfa over a 3-year period.

The feasibility of accumulating Ladino-grass during late summer for late fall and winter is being studied at several locations. Usually about one ton of forage can be accumulated between August 1 and November 1. Studies have been initiated with the use of N15 on the utilization and effectiveness of applied nitrogen on the legume and grass components of a legume-grass mixture.

II. Soil Fertility:

Information concerning the number of years over which a given rate of limestone is effective is being obtained with Ladino and alfalfa. In the fifth year after seeding, 1-ton rates produced less than half as much forage as the 2-ton rates; also in the fifth year, 2-ton rates were showing slight inferiority to the 4-ton rates.

In studies with pure stands of tall fescue, 7000 to 10,000 pounds of forage in addition to 300 pounds of seed per acre have been produced by applying 200 to 400 pounds of elemental nitrogen.

III. Grazing: (Animal Industry and Agronomy cooperating).

Beef Cattle:

Five rates and dates of nitrogen application on a pure stand of tall fescue are being evaluated with beef cattle. The pastures have been grazed April through August and November through January. In 1951, 694 pounds of beef per acre were obtained from paddocks receiving 100 pounds N. in October and 100 pounds N. in February. In 1952, the yields were 346 pounds of beef per acre. The number of "Calf days grazing" per year was approximately 600.

By accumulating forage of Ladino-grass from August 1 to Nov. 1 during 1952, $1\frac{1}{2}$ acres carried one cow 100 days. Before January 1 gains up to $1\frac{1}{2}$ pounds daily were obtained.

A study with beef cattle comparing different levels of grain feeding on Ladino and on Ladino-tall fescue, and a rotational grazing experiment have been initiated.

Dairy:

Experiments at two locations with milking cows comparing Ladino, Ladino-orchardgrass, Ladino-tall fescue and tall fescue have been initiated. Rotational grazing is also being studied and two irrigation experiments are being continued.

IV. Breeding:

Emphasis in the breeding program is primarily centered on alfalfa and the annual and perennial lespedezas.

Annual lespedezas:

Tests with pure cultures of 5 rootknot nematode species showed that Rowan lespedeza has resistance to two species. Tests of F₅ generation progenies from Rowan crosses indicate that resistance has been transferred to later maturing lines. A heritability study in annual lespedeza is also nearing completion.

Perennial lespedezas:

Three thousand interspecific pollinations have shed considerable light as to where germplasm can be transferred between species. Attempts are being made now to double the chromosome number in vigorous, sterile hybrids. Induced tetraploids in sericea are also being compared with diploids.

Alfalfa:

Hay yields of 14 N.C. synthetics and composites tested in 1952 averaged 114% of the checks, ranging from 101 to 129%. In selection for disease resistance, the greatest advance has been made for rust and leaf spots. Immunity or a high degree of resistance has been isolated in the case of rust. As to commercial varieties tested, Atlantic ranks among the best.

Oklahoma: J. R. Harlan, reporting.

Dr. J. R. Harlan reported that tall fescue is a good grass for eastern Oklahoma if managed properly. A new variety of Bermuda called Midland is being increased for release. Midland is more winter-hardy than Coastal Bermuda. A seed production facility has been established. Methods of testing chaffy seed of various grasses is being studied at the present time. Because of the diversity of climatic conditions, three varieties of annual lespedeza are recommended in the state. Twenty-four grasses and 12 legumes are being evaluated under a wide range of climatic conditions. A wide collection of legumes are being screened in an effort to secure better adapted species for Oklahoma conditions.

Puerto Rico: - Mr. Efrain Boneta-Garcia, unable to attend this session, turned in an abstract of the work under way as follows:

I. Improvement of Forage Grasses for Puerto Rico.

The grass collection and appropriate propagating plots are maintained. Thirty varietal additions were obtained from material introduced from foreign countries mainly through the Regional Plant Introduction Station at Experiment, Georgia. These were planted and observed as to adaptation and agronomic characteristics. Some of them were eliminated for poor adaptability to our soil and climatic conditions.

Cytological studies were made with strains of Buffel grass (Pennisetum ciliare).

The 5 lines of the original cross of Panicum maximum clone Guinea x Panicum maximum clone Gramalote were included in two regional tests planted at the Lajas substation and near Santa Isabel in the south on a private farm belonging to Sucn. Fernando A. Vendrell Gandia, comparing them under dry conditions with other strains of P. maximum. To the one in the south, 5 strains of Buffel grass were added and 2 harvests have been made of this trial. Another regional test using soilage grasses was established at Rio Piedras. Four cuttings have been made in this experiment.

The regional tests at Corozal where three groups of grasses; soilage grasses, range grasses and double purpose grasses, were used, were completed after 10 cuttings and the data obtained is presented in tables 1, 2 and 3.

Propagating material of the most promising grasses such as Selection #208 x #1, commonly called Merker and Pangola, have been widely distributed to farmers of different regions of the Island.

II. Grazing Experiments.

The second year of the grazing trial was finished at Yabucoa. The experiment was ended on request of the cooperator. The results for the two years were pooled together as follows:

<u>Grasses</u>	<u>Days in experiment</u>	<u>TDN per acre (lbs.)</u>	<u>Standard cow days</u>	<u>Carrying capacity</u>
Pangola	579	10243.18	640.20	1.11
Guinea-Kudzu	579	12974.42	810.90	1.40
St. Augustine	499	9450.34	590.65	1.18
Para	452	6358.45	397.40	0.88

The average chemical analysis on a dry basis for the grasses for the 2-year period were as follows:

Grasses	Total moisture	Ash	Crude protein	Fat	Fiber	N.F.E.
Pangola	78.99	9.78	10.18	2.01	29.84	48.18
St. Augustine	77.51	9.43	8.14	1.55	29.79	51.39
Guinea-Kudzu	78.61	11.18	12.75	1.98	30.23	43.09
Para	78.87	10.46	11.21	2.20	29.25	46.87

The gains in weight and gross income per acre for each year are given below. In computing the gross income, the price per pound on hoof of 17 cents, authorized by the Office of Price Stabilization, was used.

Grasses	1951		1952	
	Gain in wt. lbs. per A	Gross income	Gain in wt. lbs. per A	Gross income
Pangola	696.66	\$118.43	933.33	\$158.67
Guinea-Kudzu	806.66	137.17	1053.33	179.07
St. Augustine	573.33	97.46	730.00	124.10
Para	513.33	87.27	400.00	68.00

Some observations made in relation to the management of these grasses are as follows:

1. Although rainfall was more than enough for Para grass the sandy soil in which the experiment was established was not too good for this grass. Para grass likes wet heavy soils on which it thrives very well.
2. Pangola is very resistant to trampling but in a situation of prolonged rainfall with slow drainage as in this experiment, some damage from trampling results. This grass recovers very fast.
3. In spite of the fact that the grasses were all fertilized at the same time and with the same fertilizer, the mixture of Guinea-Kudzu maintained, on the whole, a higher percentage of crude protein.
4. St. Augustine grass matures rapidly, making it hard and somewhat unpalatable to the animals grazing it. It is very resistant to trampling.

The grazing trial at Lajas Substation started with only fertilized and unfertilized Guinea grass. We were not able to get the kudzu to grow there.

Table 1. Results obtained from a regional test carried out with soilage grasses at the Corozal Substation in a Lares clay soil, planted May 23, 1950.

Variety	Green forage - Tons per A		Average crude
	Total yield	Annual yield	protein percent in dry matter
<u>Pennisetum purpureum</u>			
(F ₁ #208 x 1)	155.10	72.76	10.26
Merker	145.45	68.20	10.68
#29722 x Millet 16(1:1)	138.90	65.15	10.46
Elephant	138.80	65.11	11.75
Florida	136.80	64.17	11.43
#29722 x Short 16 x 18(3:1)	131.45	61.66	11.55
#29722 x Short 16 x 18	126.30	59.24	11.45
Selection #169	120.30	56.43	11.17
Hybrid 7353	116.60	59.70	11.72
" 7350	115.50	54.19	10.89
" 7354	109.65	51.45	10.40
" 7351	104.25	48.91	11.49
" 7352	100.35	47.09	10.73
Dwarf Elephant	97.30	45.64	12.53
#208	88.75	41.63	12.62
Tripsacum laxum Guatemala	84.75	39.77	11.70

Varieties superior in this test with no significant difference among themselves were: Pennisetum purpureum (F₁ #208 x 1), Merker, #29722 x Millet 16(1:1), Elephant, Florida and #29722 x Short 16 x 18(3:1).

Table 2. Results obtained from a regional test using double purpose grasses in a Lares clay soil at the Corozal Substation, planted May 23, 1950.

Variety	Green forage - Tons per A		Average crude protein percent in dry matter
	Total yield	Annual yield	
<u>Panicum maximum</u> , Canal Zone	127.65	59.88	8.67
" " Gramalote	126.15	59.17	10.60
" " Brazil	109.15	51.19	9.54
" " Guinea from El Salvador	86.15	40.42	8.67
" " Common Guinea grass	82.30	38.62	10.36
<u>Axonopus scoparius</u> Imperial grass	53.50	25.09	11.12
<u>P. maximum</u> Borinquen Guinea	44.10	20.68	9.73
" " Coarse	43.05	20.20	12.12
" " Fine	33.40	16.13	11.40

Panicum maximum, Varieties Canal Zone & Gramalote were superior to all in this test.

Table 3. Results obtained from a regional test with range grasses in a Lajas clay soil at the Corozal Substation, planted May 23, 1950.

Variety	Green forage - Tons per A		Average crude protein percent of dry matter
	Total yield	Annual yield	
<u>Paspalum fasciculatum</u>			
Venezuelan grass	104.55	49.06	9.14
<u>Digitaria decumbens</u> Pangola	88.90	41.70	7.42
<u>Helinus minutiflora</u>			
Molasses grass	64.15	30.09	8.77
<u>Paspalum notatum</u>			
(Common Bahia x Pensacola Bahia)	40.75	19.13	10.00
<u>Cynodon dactylon</u>			
Bermuda Selection #104	38.10	17.87	8.56
Bermuda Selection #99	36.20	16.99	9.21
Bermuda Selection #3	35.50	16.72	9.90
Coastal Bermuda	32.00	15.02	12.03
<u>Stenotaphrum secundatum</u>			
Giant St. Augustine grass	12.25	5.75	9.76

P. fasciculatum was superior to all grasses in this test.

III. Hay Making

The preliminary results of hay curing at Lajas are summarized as follows:

Variety	Percent		Hours dried	Percent moisture	Remarks
	Age when cut(days)	moisture when cut			
Pangola	40 ¹ / ₁	72	51	37	Rain spoiled test.
"	60 ² / ₁	63	24	49	" " "
"	96 ¹ / ₁	60	53	30	
"			72	32	
Coastal Bermuda	61 ¹ / ₁	51	24	30	
" "			28	24	
" "	96 ¹ / ₁	43	5	27	
" "			24	22	
" "			28	20	

¹/ Cut at 11:00 A.M.

²/ " " 11:30 "

IV. Economic Aspects of Roughage Production and Conservation.

The work on the economic aspects of roughage production and conservation was finished this year. After analyzing all the phases investigated we arrived at the following conclusions in addition to those pointed out in the last progress report (1951-52).

1. The cost of producing 100 pounds of digestible matter is less for Merker grass when the whole plant is taken into consideration. When only the leafy part is considered the cost of producing 100 pounds of digestible matter is lower for Guinea grass than for the other two.
2. Guinea grass produces approximately 30 percent more leaves, which is highly nutritive matter, than Merker or Para grass. This advantage is maintained up to the age of 120 days. Merker and Para grasses lost from 5 to 10 percent of leaves from 40 to 90 and 120 days of age, starting with approximately 50 percent at 40 days.
3. Total production per acre is much greater when the grasses are cut at 40-day intervals. At the same time, the nutritive value is also greater. The protein percentage at 40 days of age was almost double that at 90 and 120 days. Lignin was much lower at 40 days as compared to the 90- and 120-day-old grasses.
4. At 40 days of age the grasses were almost equal in chemical analysis and practically equal in nutritive value. As they grew older some differences were found, principally in lignin content. This tends to indicate that if there are specie differences they appear at a later age than 40 days.
5. Twenty-four hours of wilting did not affect nutrients other than carotene. No effect was found either in the conservation of those nutrients in the silos. No differences in quality were noted due to a shorter or longer wilting period, however, those silos where the material went in quite wet had more intangible losses and less top spoilage. The intangible losses were due to the water draining off at the bottom. It is recommended that the material wilt for some hours in order that dew/evap-^{or rain} orate. In this way larger amounts of dry matter can be stored in the silos with the least losses. Too much wilting will make the material too light for good packing.
6. In spite of the loss of one third of the carotene in 24 hours of wilting the grasses still contained enough carotene to meet the nutritive requirements of our dairy cows. It was also found that carotene increased in the silos.

South Carolina: A. B. Prince, reporting.

Dr. A. B. Prince reported that the research program with forage crops is new but that work plans are being developed. Emphasis at the present time is on fertility studies in the Piedmont and Coastal Plain soils. Studies are aimed at evaluation of biennial, annual and semi-annual applications of fertilizer on the two soil regions.

Tennessee. J. K. Leasure, reporting.

Fairly rapid expansion is planned of actual grazing trials on mixtures of orchardgrass and Ladino, fescue and Ladino, both grasses with Ladino, and grasses alone, with and without N. applications. Small plots to be clipped will be located adjacent to the grazing area so correlations between grazing and clipping can be determined. Regular work in mixture evaluation and response of pastures to irrigation will be continued.

Texas: E. C. Holt, reporting.

Cytological and morphological studies have been conducted with Pennisetum ciliare and Cenchrus setigerus. Varying chromosome numbers from 32 to 54 have also been observed. Progeny produced from open pollinated seed are uniform in type. These results indicate apomictic reproduction in each of the species.

In the ryegrass breeding program selfed seed were obtained from a number of crown rust resistant plants and these progenies were established in the field in the fall of 1952. Segregation for rust resistance occurred in all lines and rust resistant plants were again selfed.

Studies to determine factors influencing the establishment of Dallis grass indicate that seed quality and the date of seeding are more important factors than seedbed preparation or surface mulch crops. Studies have just been initiated to determine factors influencing the establishment of lespedeza.

Method and rate of seeding studies with fescue have indicated that much lighter seeding rates than are now being recommended will result in good stands of fescue. No difference in yield was obtained the first year among row spacing of 7 to 35 inches. Neither row spacings nor seeding rates influenced summer survival of fescue the first summer.

Friday, June 12, 1953

SPLIT SESSION I Pasture Production and Management Techniques -
G. E. Killinger, Chairman, Florida Agricultural
Experiment Station.

Dr. Killinger called the session to order and proceeded with the program as planned.

8:15 A.M. Pasture Irrigation, Techniques and Results in Tennessee -
R. H. Lush, Tenn. Agric. Expt. Station.

Work at Columbia, Tenn., starting in 1938, using a low pressure sprinkler system, showed a profitable reduction in feed costs but little response from irrigation of low-growing plants like Bermuda grass or bluegrass. In later work(1945-48) with white clover-orchardgrass-

* Others of the Tenn. Agric. Expt. Station, USDA, Bureau of Dairy Indus., etc., have aided in work reported.

bluegrass pasture, cows produced 43 percent more milk and more income above feed and irrigation costs than cows on similar non-irrigated pasture. A test in 1950 where 120 pounds of nitrogen was applied with irrigation showed 45 percent increase in yield of forage of which 82 percent was produced after June 16.

Two years' work (1951-52) at the Cooperative Dairy Experiment Station at Lewisburg, with rotationally grazed and uniformly fertilized alfalfa-Ladino clover-orchardgrass pasture has shown a profitable response to heavier sprinkler irrigation. The 2-year average was 49 percent more cow-days of grazing, 4302 pounds or 54 percent more 4%-fat-corrected milk with a return above irrigation costs of \$115.53 per acre. An average of 20.5 inches of water, 12 inches above normal rainfall, was applied between May 1 and October 1 at a cost of \$2.49 per acre-inch. More Ladino clover and less orchardgrass now remains on the irrigated sections than on non-irrigated areas. Chemical analyses of vegetation indicated little difference in crude protein, fiber and ash content for either June 15 or October 15.

Irrigation to supplement variable rainfall, together with adequate fertility and suitable vegetation, offers an opportunity to profitably increase production of milk when needed where a suitable supply of water exists, and especially if the equipment can be readily used on other high value crops or to establish new seedings. Equipment should not only be installed for ease of moving but to give proper spacing between sprinklers for even distribution and a rate of application no greater than the infiltration rate of the soil.

E. H. Stewart, South Carolina, asked Dr. Lush why less alfalfa is found on irrigated plots than on non-irrigated. Dr. Lush felt that watering gave Ladino and orchardgrass more of a competitive advantage than they had without irrigation.

8:40 A.M. Results of Eight Years' Fertilization and Irrigation Experimentation on Bermuda-Clover Pastures - O. E. Sell, Ga. Agric. Expt. Station.

As part of an overall experiment on "Limiting Factors in Pasture Production", the effect of supplementary irrigation was studied in connection with 18 rates and combinations of applying the 3 major fertilizer elements, N, P, and K. Limestone was applied to both irrigated and un-irrigated series of plots. Effects of supplementary watering will be considered in relation to the following major topics:

1. Yield of forage dry matter per acre.
2. Seasonal production, per acre per day.
3. Crude protein yields per acre in forage.
4. Botanical composition of forage.
5. Increased fertilizer needs.

The plot area at the start contained Bermuda but hulled seed was sown. A mixture of white, hop, Persian and subterranean clovers and black medic

were sown in fall and lespedeza was sown in spring. Phosphate and potash and lime materials were topdressed every 3 years while nitrogen was applied twice each season. Supplementary water was applied with a wheelbarrow type apparatus to which perforated pipe, covering the plot width, was attached. A water meter was used to apply the same amount of water to all fertilizer treatments in the watered series. The total annual amount of irrigation water applied varied with rainfall conditions from none to 12 acre-inches. One period in late May and June usually required irrigation and another period in August to October. Pertinent data is given in the tables that follow.

Eight-year Average Yield of Clovers and Bermuda Grass,
1938-1945.

Fertilizer treatment ^{1/}	Dry matter yields - Pounds per acre					
	Total		Clovers		Bermuda grass	
	No irr.	Irrgtn.	No irr.	Irrgtn.	No irr.	Irrgtn.
Water	- -	1690	- -	290	- -	820
Control	1980	2510	550	740	900	990
P	2490	3070	980	1330	1120	1100
2P	2800	3310	1270	1420	1240	1300
2PK	3110	3620	1390	1840	1230	1150
4P	3010	3500	1230	1520	1320	1340
N	2800	2920	690	900	1690	1670
NP	3190	3800	1110	1490	1720	1890
NPK	3340	4090	1090	1440	1860	2090
2N	3130	3760	570	1000	2180	2570
2NP	4130	4530	1170	1580	2670	2680
2NPK	4340	5230	1320	2230	2770	2710
2NPK	3770	4330	1000	1700	2500	2290
4N	4310	4490	470	570	3730	3730
4NP	4930	5870	720	990	4030	4630
4NPK	6050	6650	1250	2590	4650	3860
4N2PK	5490	5970	1010	1890	4360	3880
4NPK	5100	5140	780	1250	4130	3700

^{1/} N. is equivalent to 32 lbs. N applied per acre annually, half in late spring and half in mid-summer. P is equivalent to 48 lbs. P₂O₅, and K is equivalent to 50 lbs., K₂O applied once every 3 years.

Dry Matter Production During Season of 1944 as Affected by Irrigation.

Fert. treat- ment	Pounds dry matter produced per acre daily							
	4/29-5/24		5/24-6/22		6/22-7/19		7/19-8/2	
	No irr.	Irrgtn.	No irr.	Irrgtn.	No irr.	Irrgtn.	No irr.	Irrgtn.
Control	6	15	4	20	16	28	13	17
2PK	18	41	8	28	33	42	18	20
NPK	13	33	11	28	34	42	28	33
2N	6	14	13	28	29	34	28	38
2NPK	15	45	16	31	37	44	32	38
4NPK	12	42	25	38	56	47	64	56

**Effect of Supplementary Irrigation on Per Acre Dry
Matter and Crude Protein Yield, 1944.**

Fertilizer treatment	Dry matter yield			Crude protein yield		
	No irr.	Irrgtn.	Increase	No irr.	Irrgtn.	Increase
	lbs.	lbs.	%	lbs.	lbs.	%
Control	2650	3520	33	300	545	82
NPK	4570	6350	39	563	1181	110
2P	3620	4910	36	583	889	53
2PK	4630	6320	37	654	1040	59
2NPK	5690	7430	31	766	1349	76
4N	3490	5000	43	605	967	60
4NPK	8000	8390	5	930	1490	60
Average	4660	5990	29	629	1066	69

**Effect of Supplementary Irrigation on Botanical
Composition of Herbage, Eight-year Average, 1938-1945.**

Fertilizer treatment	Percentage Composition of Herbage			
	Clovers		Bermuda	
	No irrgrtn.	Irrigated	No irrgrtn.	Irrigated
1 Control	26	26	46	42
5 NPK	26	33	55	53
7 2P	33	46	46	36
9 2PK	36	39	44	34
10 2NPK	28	37	62	56
12 4N	11	13	87	83
15 4NPK	20	38	80	61

**Irrigation Effect on Herbage of Clover
Species, April 12, 1944.**

Fertilizer treatment	Percentage of total clovers consisting of:					
	Ladino		Hop clover		Subterraneum	
	No irr.	Irrgtn.	No irr.	Irrgtn.	No irr.	Irrgtn.
Control	18	73	73	23	9	4
NPK	25	89	53	9	21	2
2P	34	87	60	13	6	0
2PK	44	92	46	6	10	2
2NPK	19	86	53	10	28	4
4N	2	19	74	78	24	3
4NPK	24	80	63	17	12	3

Soil depths (inches)	P. p. m. of available P ₂ O ₅ in soil					
	1941		1943		1944	
	No irr.	Irrigtd.	No irr.	Irrigtd.	No irr.	Irrigtd.
0-2	164	114	110	102	142	53
2-4	53	41	57	61	88	33
4-6	30	13	34	30	36	9
6-8	10	2	2	10	36	9
8-10	--	--	2	10	0	1
10-12	--	--	1	9	0	1

In interpreting the above data it should be remembered that the lime, phosphate and potash were topdressed in the fall of every third year---1936, 1939, 1942. In 1943, the year following mineral fertilization, supplementary watering appeared to increase the amount of available P at the lower soil depths. In 1941 and 1944, years farther removed from fertilizer application time, there is a definite evidence of reduced soil fertility as a result of supplementary watering, presumably due to increased forage production and thus increased removal of plant food nutrients from the soil. Other soil data on available Ca and Mg show the same trend. Soil pH data show definitely that supplementary watering increased the soil pH at least to a depth of 12 inches, compared to soil liming without irrigation. The use of N and K in addition to P decreased the amounts of available soil P at all soil depths. These data all emphasize that as any one factor limiting pasture production is removed, there is a greater demand on the other factors involved in pasture production. Thus, supplementary irrigation of pastures will require appreciably higher rates of fertilization.

Conclusions that may be drawn from the data shown and from additional information on hand are:

1. Supplementary irrigation increased total pasture forage production, largely through an increase in clover production.
2. Increased production resulting from supplementary irrigation was not limited to dry periods in a season--there was an important carry-over effect into good rainfall periods in that Ladino clover survived hot, dry periods and was able to increase total production later in normal rainfall periods. This carry-over effect also applied to spring production following irrigation in fall.
3. Forage crude protein production was increased twice as much as forage dry matter by supplementary irrigation.
4. More important than the increase in percentage of total clovers was the increase in percentage of Ladino clover in the herbage due to irrigation.
5. Soil and plant analysis both emphasize that greater quantities of plant food nutrients are removed from the soil as a result of supplemental irrigation so that higher rates of fertilization are necessary to sustain pasture production over a period of years.

From two to three times more yield of top and root growth of carpet, Bermuda and Dallis grass were obtained by frequent watering (saturated every 5 days), than when grown under drought conditions (saturated every 15 days). Under the 10-day interval of watering slight wilting was observed on only a few occasions, yet plant growth under these conditions was also inferior to frequent watering. For these 3 plants the optimum amount of water seemingly was well above the wilting percentage.

In a different experiment, orchardgrass produced much higher yields under a system of infrequent watering whereby the plantings exhausted the soil moisture to the wilting percentage, than under frequent saturation (5-day interval). Alfalfa, however, was greatly favored by frequent saturation (5-day interval).

In a field experiment, the production of Ladino-tall fescue is being studied, with and without supplemental irrigation. During 1951 and 1952, 69 percent more "Days on Pasture" and 52 percent more TDN were obtained under irrigation. Approximately 14 inches of supplemental water were added annually. The moisture-holding capacity of each paddock was determined. The "available" moisture-holding capacity (P.C. to 15 atmospheres) to a depth of 14 inches, varied from 2.32 inches to 1.08 inches between paddocks. A balance sheet is maintained recording daily precipitation and expected daily evapotranspiration, and the paddocks are irrigated accordingly.

Studies are under way in which evapotranspiration of Ladino-grass and an alfalfa sod are being determined under field conditions.

Discussion: Dr. Blaser asked if the quality of the herbage varied under irrigation versus non-irrigation. Dr. Chamblee stated that no specific measurements were taken but in some cases where ample growth was being made without irrigation, more milk was produced than under irrigation. Actually, the data is insufficient on this point.

Dr. Blaser stated that this particular point should be investigated because quality effects of irrigation may be equally as important as yield. Dr. Beard asked if any trouble occurred with "evapo-transpirometer" tanks caused by the soil cracking away and shrinking from edges inside of the tank. According to Dr. Chamblee, this did not occur in these tests.

9:30 A.M. Evapotranspiration and Irrigation Requirements of Pasture Species - D. E. McCloud, Fla. Agric. Expt. Sta.

Evapotranspiration is the movement of water from the soil and plant into the atmosphere. It is the reverse of precipitation and is useful in determining irrigation requirements of crops using a simple book-keeping procedure, with additions for rainfall and subtractions for

* The above experiment is being conducted cooperatively by Animal Industry, Agricultural Engineering and Agronomy. The evapotranspiration studies are being conducted cooperatively with Tenn. Valley Authority.

evapotranspiration losses.

Since temperature markedly influences physical and physiological processes, several workers have developed formulas for estimating water loss from mean temperatures. The usefulness of this approach depends upon its accuracy. A comparison of several of these calculated values to actual measured water loss at Gainesville, Florida, shows measured potential evapotranspiration to be much higher than any of the calculated ones.

Discussion: Dr. Lucas North Carolina, asked if evapotranspiration was a function of the amount of moisture present. Dr. McCloud stated that it was but probably varied from soil to soil.

E. H. Stewart, South Carolina, asked if humidity and air velocity affect evapotranspiration. Dr. McCloud answered that it probably does affect it and that data is being collected to evaluate this question.

10:00 A.M. Intermission.

10:15 A.M. Evaluating Pastures, Consumption vs. Cage and Chemical Data - L. N. Wise, Miss. Agric. Expt. Station.

Attempts are often made to explain or predict animal response on the basis of the conventional chemical analysis of the forages in question. Such chemical analyses are expensive and conclusions reached are often misleading.

The standard feed analysis was devised for concentrates rather than forages. Attempts have been made to modify these analyses with varying degrees of success. Primarily they have involved a different breakdown of the carbohydrate fraction.

The lignin content of forage has been shown to bear a highly significant negative relationship to the digestibility of the other fractions and to gains made by animals consuming this forage. These results, however, were obtained under conditions of controlled or known intake. In grazing trials conducted at Purdue University, the expected negative correlation between the lignin content of the forage and animal response was obtained on one pasture mixture but completely opposite results obtained on another. In the latter case there was a significant positive correlation between the lignin content and the TDN yield.

Valid interpretation of the relationship between the chemical composition of forages and the obtained or predicted animal response is not believed to be generally possible in the absence of accurate consumption data.

Dr. Lucas suggested that partial correlations might be more useful than simple correlation coefficients.

The results to be presented are preliminary ones from an investigation into the distribution of excreta by freely grazing animals and its effect on the maintenance of pasture fertility.

Two aspects of the distribution must be considered. The first of these is the tendency of the animals to distribute excreta at varying density over the pasture (here called the "spatial" distribution). As is well known density is higher around water troughs, salting stations, along fences, etc. Superimposed on the spatial distribution is one which operates through time and is very closely approximated by the Poisson distribution. Given the tendency of the animals to deposit excreta at a certain point in the pasture, the Poisson distribution defines the probability that the given point will be covered by 0, 1, 2, etc., excretions in a finite period of time.

A quantitative expression for the spatial distribution has not been devised, although its major features have been recognized. An idea of the effectiveness of return of fertility by the animals nevertheless can be obtained. This can be done by assuming a uniform spatial distribution, i.e., by examining the phenomenon as though only the Poisson law were operating, and then making some allowance for non-uniformity of the spatial distribution. Under the assumption of a uniform spatial distribution, and with reasonable figures assumed for excretion rate and area covered by a single excretion, the expected proportions of the pasture covered can be computed for various lengths of time. Example figures are as follow:

		Approximate percent of area covered by:			
		0	1	2	3 or more
Excretion	of grazing	excretions	excretion	excretions	excretions
Feces	1 year	91	9	1	0
	5 "	61	30	8	1
Urine	1 year	82	16	2	0
	5 "	37	37	18	8
Urine or Feces	1 year	74	22	3	1
	5 "	22	34	25	19

The spatial distribution is of such nature that the percentages of area covered by zero and high numbers of excretions are somewhat greater than the table indicates. If grazing is continued long enough, of course, essentially all points on the pasture will have been covered.

From the above table it is evident that the maintenance of fertility depends in large share on how rapidly a nutrient disappears from a spot covered by an excretion. If a nutrient disappears rapidly and animal excreta are the only fertilizers applied, only a very small portion of the pasture will be in a desired state of fertility with respect to that nutrient at any given time. For example, on a pure grass sod, it appears that only 10 to 20 percent of the pasture will be maintained in a desired fertility state with respect to nitrogen, no matter how long grazing is continued. Thus, heavy applications of N continually will be required. On the other hand, if a nutrient is slowly lost, such as is the case with potassium under some conditions, then, after a considerable period of time at least, it appears that the animal excreta will maintain fertility fairly effectively. That is, one will need apply the nutrients in amounts only moderately greater than the amounts carried off the pasture in the animal body. These amounts should be applied differentially, of course, to compensate for the non-uniformity of the spatial distributions.

Discussion: Dr. Killinger asked if heavy rotational grazing could have a different effect. Dr. Lucas stated that under such conditions pasture effect would tend to disappear and distribution would be pure Poisson.

11:15 A.M. Summary of Pasture and Forage Evaluation Techniques in Virginia - R. E. Blaser, Va. Agric. Expt. Station.

Dr. Blaser summarized the techniques being tried for evaluation of (1) Palatability, (2) Nutritive value, and (3) Forage quality. The palatability studies are conducted with animals that have been grazing various kinds of pastures. They are then turned into an area where they have free choice of various pure stands and mixtures. The percent of available herbage eaten is taken as an estimate of palatability. In one test at Middleburg, 62, 56, and 47 percent of available herbage of orchardgrass-Ladino, orchardgrass-lespedeza and orchardgrass alone was consumed by the grazing animal. In the same test, 47 percent of a Ky. 31 fescue-Ladino mixture was consumed as compared to 27 percent for Ky. 31 fescue alone. Forty-four percent of available herbage of a Ky. bluegrass-white clover pasture was consumed. Palatability alone is not always indicative of nutritive value.

Nutritive value is measured by daily gains made when animals are confined on a single pasture. The nutritive value of 6 pastures has been determined over a 3-year period at the Middleburg Station. The 3-year average daily gains per animal for orchardgrass-Ladino, orchardgrass-redtop-lespedeza, Ky. bluegrass-white clover, Ky. 31 fescue-Ladino, orchardgrass alone and Ky. 31 fescue alone were 1.23, 1.21, 1.16, 1.11, 1.00 and .98 pounds, respectively.

The Virginia Station is working on producing high quality forages rather than high yields. Studies are under way to determine the feeding value of pasture herbage of different maturity.

SPLIT SESSION II. Forage Breeding Techniques - P. C. Sandal,
Ark. Agric. Expt. Station

8:15 A.M. x Methods of Forage Improvement - E. C. Holt, Tex. Agric. Expt.
Station; A. A. Hanson, BPISAE, USDA, Beltsville, Md.; C.
H. Hanson, N. Car. Agric. Expt. Station, and C. R. Owen,
La. Agric. Expt. Station.

The general or overall methods of forage improvement as presented by Dr. Holt, was summarized as follows:

1. Fundamental studies: The need for fundamental information on the cytology, morphology and breeding behavior of a species as a basis for the breeding program is emphasized by the reports of irregularities in the reproductive process of many species. These include the work of side-oats grama by Harlan (2), the work on subterranean clover in Australia (17), Dallis grass (11) and Guinea grass (13). Additional information on mode of pollination, meiotic behavior and the inheritance of characters is also needed.

2. Clonal evaluation: Performance of clones in replicated tests is generally not considered an adequate measure of the breeding potential of the clone. Some type of progeny test is necessary. Recent studies (6, 7, 14) with orchardgrass and crested wheatgrass have indicated that open-pollination progeny tests give as good or better measure of breeding behavior of the clone as self, polycross, top cross or single cross progeny.

3. The use of inbreeding: The effects of inbreeding and the use of inbreeding in the improvement program have been discussed by Myers; Hanson, Myers and Garber (1); Hawk and Wilsie (4, 16); Wilsie (15); McAllister (8); and Murphy and Atwood (10). In general, it has been found that self-fertile lines can be developed in most species and that self-fertility does not result in self-pollination under open-pollination conditions. Lines developed through one or more selfings may be equal to or superior to the parent clone in general combining ability. Inbreeding appears to have a definite place where uniformity for certain characters such as disease resistance, maturity, height, etc., is desired.

4. Recurrent selection: Recurrent selection, which is a mild form of inbreeding, has proven effective in corn (12), side-oats grama (3) and sweet clover (5). This is a system of improvement which can be adapted to almost any crop and is less laborious than inbreeding or some of the other procedures used in improvement programs.

Specific examples of procedures being used in breeding programs were presented as follows:

Ryegrass Breeding - E. C. Holt:

1. Objectives: Development of a crown rust resistant line which exhibits earlier fall growth than common ryegrass.

2. Procedure: (1) Identification of rust resistant plants. (2) Resistant plants selfed for two or three generations. (3) Seed from resistant lines will be planted in an isolation block for inter-crossing. (4) Identity of material in the crossing block will be maintained and tested for fall vigor. (5) If serious reduction in vigor occurs with the second selfing, a system of controlled pollination or a season of open-pollination will be used for restoring vigor.

Breeding Methods - A. A. Hanson:

The interrelationship of breeding objectives to breeding methods was considered, together with the fact that superior breeding methods will not compensate for nebulous objectives. Varietal development should be directed toward increased efficiency of production. The standardization of grass breeding procedures should not be overstressed, especially in light of the differences that exist among species in mode of reproduction, genetic and cytological behavior and the conditions under which they will be shown. There is every reason, especially from the standpoint of our present knowledge of the economic grasses, to improvise, experiment, and use radical approaches in our quest for superior grasses. Provision should be made in breeding programs for a continuous study of the nature and extent of the variation within a species. At an early stage in the program consideration should be given to supplementing the natural variation by crossing ecotypes, species and perhaps genera. The suggestion that a wide gene base is essential to the production of successful synthetic varieties was reviewed from the standpoint of the potential that may be exhibited by varieties possessing a relatively narrow gene base.

Lespedeza Improvement - C. H. Hanson:

1. Floral morphology and development of Korean lespedeza. Showy and cleistogamous flowers are quite different in gross morphological characteristics and in mode of pollination, but the essential features of reproduction appear identical in the two flower types. In the showy flowers (less fertile than cleistogamous flowers but used in crossing due to greater size) the style is longer than the anthers during all stages of bud development, thus permitting hand pollination in the bud stage without disturbing the anthers. The ovary is receptive several days before anthesis. The relative numbers of showy and cleistogamous flowers are determined largely by environmental conditions.

2. Intraspecific hybridization in Korean lespedeza.

(a) Crossing techniques. Omitting emasculation in the crossing procedure resulted in a 9-fold increase in seed set over conventional methods involving emasculation. Showy flowers are delicate and sensitive to manipulation.

(b) Testing for resistance to root-knot nematodes and transfer of resistance. Chitwood's breakdown of root-knot nematodes into species and the use of pure cultures of these species in testing for resistance have greatly facilitated selection for resistance. It is now known that Rowan lespedeza has resistance to two forms. Resistance has been transferred to later maturing lines.

(c) Estimates of heritability. Estimates of heritability and expected advance from further selection have been obtained with little additional cost during routine testing of F₃ to F₅ generation progenies.

3. Interspecific hybridization. Eight species hybrids (including reciprocals) have been obtained, providing information as to the transfer of desirable genes between certain species. Doubling the chromosome number of sterile hybrids to produce the amphidiploids may also lead to immediate practical results.

4. Tetraploid sericea. Induced tetraploids have larger and greener leaves and somewhat coarser stems than the diploids. Seeds also are 35-50 percent larger, a factor of importance in increasing seedling vigor. Chemical, agronomic and cytological data are being obtained on selected tetraploid and diploid lines.

Louisiana White Clover - C. R. Owen:

Mr. Owen reported that considerable success had been obtained in improvement of Louisiana white clover. Superior strains have been secured which are widely accepted by Louisiana farmers. The specific object in the Louisiana clover breeding project has been that of selecting clones having the ability to persist through the summer months. The plan of the breeding program is essentially that of (1) studying a large number of clones, (2) selecting those clones conforming to a specific objective, (3) growing selected clones in a polycross nursery and testing polycrosses, and (4) combining the better clones into a synthetic strain.

9:05 A.M. Role of Intra- and Inter-generic Hybridization and Polyploidy in Forage Crop Improvement - L. V. Crowder, Ga. Agric. Expt. Station.

Dr. Crowder briefly reviewed much of the extensive work which has been done. He has briefly summarized it as follows:

Effects of polyploidy. Depends on nature of original genotype. Wider distribution, increase in cell size and cell inclusions, slower growth rate, lower fertility, increased self-incompatibility, genetic barrier with diploid.

Autopoloids

1. *Lolium perenne* (Meyers 1939, 1945) produced with difficulty, mixopoloids, larger pollen, low seed germination.

2. Red clover (Randolph 1941, Levan 1942, Noggle 1946, Julien 1949): slightly higher forage yield, more persistent, slower growth, low fertility and seed set reported earlier but apparent increase after selection.

3. Alsike clover (Julen 1949): More promising than red.
4. White clover (Atwood 1944, Gershoy): Enlarged plant parts, fewer seed per pod, yield variable in comparison with Ladino, 100 plants bulked for breeders seed.
5. Lotus (Gershoy, Vt.): L. tenuis, L. corniculatus and L. uliginosus doubled, attempting to increase yield, persistence, and winter hardiness. Used in interspecific crossing.
6. Crimson clover (Metzger, S.C.): More vigorous in greenhouse, reduced fertility, mixoploids.
7. Sericea (Hanson, N.C.): Enlarged plant parts, flowered late, largely cleistogamous.

Allopolyploids: Segmental, genomic and autoallopolyploids.

1. Dactylis glomerata (Muntzing 1937, Myers 1948): Disputed autopolyploid of D. aschersoniana or allopolyploid of it and Dactylis sp.
2. Lotus corniculatus: Segmental allopolyploid or autopolyploid, shows largely bivalents but tetrasomic inheritance. Data variable in crosses with autopolyploid L. tenuis.
3. Bromus catharticus. (Stebbins & Tobgy 1944) Example of genomic allopolyploid.
4. Alfalfa - (Nilan 1951): Rhizoma probably a genomic allopolyploid. Arose from interspecific cross M. falcata ($2n = 24$) x M. sativa ($2n = 32$).
5. Johnson grass: Duara & Stebbins (1952) & Hadley (1952) report probably a segmental allopolyploid which arose from a cross of two 20-chromosome species with similar complements. Casady & Anderson (1952) believe an autotetraploid.

Intraspecific Hybridization:

1. Sudan grass: Burton (1943)-Tift Sudan from (Sudan x Leoti) x Sudan F_2 plants. Quinby and Karper (1943)-Sweet Sudan from Sudan x Leoti followed by selection & B.C.
2. Bermuda grass: Burton (1948, 1951) Coastal Bermuda from S. Afr. x Tifton selection. Coastal x Indiana strain for production and cold tolerance.
3. Sweet clover: Stevenson & White (1940), Horner & White (1941) and Rinke (1945) for low coumarin; all were relatively high.
4. White clover: Incompatibility studies (Atwood 1947).

Interspecific Hybridization:

1. Alfalfa: (Ledingham 1940; Nilsson 1943, Schrock 1943, Nilan 1951) M. sativa ($4n = 32$) x M. falcata ($2n = 16$), fertilization delayed, few seed viable, $3n$ & $4n$ progeny; Rhizoma variety ^{from} $4n$ progeny (unreduced falcata gamete). M. sativa x M. lupulina, x M. glutinosa, x M. ruthenica no seed set. M. media x M. lupulina intermediate, largely sterile, amphidiploid weak.
2. Bermuda grass: Burton (1951) crossed Star grass (Cynodon plectostachyum, $2n = 18$, a taller, coarser, larger stemmed Bermuda, with C. dactylon, $2n = 36$ (Coastal & Indiana). Progeny sterile, less winter hardy, but Indiana x Star outyielded parents.

3. Bromegrass: Knowles (1944) obtained sterile, intermediate progeny from B. mollis ($2n = 28$) x B. rubens ($2n = 28$), x madritensis ($2n = 28$), x carinatus ($2n = 56$), and fertile hybrids with B. racemosus ($2n = 28$). Other crosses but no seed set. Elliott (1949) sterile, intermediate F_1 plants with B. inermis, B. pumpellianus ($2n = 42$), and B. erectus ($2n = 42$) intercrossed. Other crosses unsuccessful. Hanson obtained hybrids from certain crosses of B. pumpellianus, erectus, anomalus ($2n = 14$), frondosus ($2n = 28$), purgans ($2n = 28$), grandis ($2n = 14$), and laevipes ($2n = 14$). Stebbins & Tobey (1944) studied phylogeny of B. carinatus, B. polyanthus and B. catharticus.

4. Dallis grass: P. dilatatum, P. mallacophyllum, P. urvellei hybrids have ergot resistance and high forage yield (Burton, 1943; Miss. Ann. Rept., 1952)

5. Johnson grass: Johnson-sorghum hybrids show disease resistance and high fertility (Miss. Ann. Rept. 1952). Johnson grass x 4n Sudan highly fertile and rhizomatous but not as vigorous as Johnson (Casady & Anderson, 1952). Sudan & Kafir x Johnson grass indicated allopolyploidy in Johnson (Hadley, 1953)

6. Lolium: Jenkins (1934, 1935) and Jenkins & Thomas (1938) described 11 of 15 possible hybrids of Lolium. Chromosome differences delimit species.

7. Melilotus: Fertile and vigorous F_1 from M. albus x M. var. Redfield; no viable seed M. albus x M. officinalis (Stevenson & Kirk (1935). Webster (1950) obtained hybrids with 7 sp. melilotus. Low coumarin from M. dentata x M. officinalis (Smith 1943). Cross fertility (Johnson 1942).

8. Pennisetum: Resistant and susceptible progeny from Napier grass (P. purpureum) x Merker grass (P. merkeri) Parris & Ripperton (1941). Burton (1944) obtained green and chlorophyll deficient progenies from Napier x cattail millet (P. glaucum). Sterile, less hardy than Napier.

9. White clover: Several weak seedlings when Trifoliums intercrossed (Garavich 1949, Trimble 1951, Kein 1952), few weak plants.

10. Zoysia: Fertile hybrids of Z. japonica, Z. matrella, Z. tenuifolia some hybrid vigor, winter hardy, low seed set (Forbes 1952).

Intergeneric Hybridization:

1. Medicago media, Melilotus albus and M. officinalis x Trigonella coerulea produced no seed. Medicago sativa x Melilotus officinalis abortive seed. (Stevenson & Kirk 1935)

2. Festuca x Lolium: Jenkins (1934), Akerberg (1938), Crowder (1952) and Buckner obtained male sterile hybrids; B.C plants some fertility.

Dr. Crowder asked Dr. R. J. Metzger of South Carolina to report on the red clover studies.

Dr. Metzger briefly reported on induced autotetraploidy in red clover. studies initiated while he was at the University of Illinois. First, second and third generations of plants from tetraploid sectors were observed for percent of aborted pollen and hand-crossed seed set, meiosis and fertility. The percent of aborted pollen in greenhouse studies varied from 16 to 24 percent while the percent of seed set from hand-crossing varied from 28 to 38 percent.

There was no relation between seed set and percent of aborted pollen. In meiosis of tetraploids, many abnormalities were observed. Limited observations indicated that the quadrivalent frequency varied from zero to 4, the average being rather low. Self-fertile tetraploid plants were observed in all three generations. Diploid sectors of self-fertile plants were self-sterile. Seed-set was less when flowers were self-pollinated than when crossed. In general, inbreeding of tetraploid plants did not result in a marked reduction in vigor.

Dr. H. W. Bennett of Mississippi, reviewed briefly the progress of his work with Dallis grass, Paspalum dilatatum, hybrids. Out of 1500 pollinations of Dallis x P. malacophyllum, five hybrid plants were obtained. Some 11,000 progeny have been tested for resistance to ergot and one immune plant has been found. In the crosses of Johnson grass x sorghum a great many types have been secured. The segregation of certain characters suggests that both tetrasomic and disomic inheritance can be exhibited. Consequently, these hybrids may be segmented allopolyploids. In each of the studies the objective has been to bring together in one line the good characters of both species.

9:55 A.M. Intermission.

10:05 A.M. Selection Indices Available in a Forage Breeding Program -
J. R. Harlan, Okla. Agric. Expt. Station.

Before considering some of the selection indices that might be useful in a forage crop breeding program it would probably be worth while to review briefly the types of things for which a breeder may wish to select. Some of these are outlined briefly below:

- I. Yield - This is the material that is produced and delivered to the animal.
 - A. Specific conditions under which the yield is produced:
Fertility level of the soil, pH, soil type, soil moisture, climate, etc. For example, in central Oklahoma, Midland yields more than Coastal because it is hardier but the Oklahoma selection yields more than Midland on poor soils because it is better suited to low fertility levels.
 - B. The components of yield: Dry matter, TDM, protein, carotene, minerals, coumarin, tannin, prussic acid, alkaloids, essential oils, sugars, lignins, fiber, fat, ergot, smut and similar diseases that cause disorders like "fescue foot" and the "shakes", bloating qualities of forage, etc.
- II. Growth Form - This is the package in which the material is delivered:
Decumbent, prostrate, erect, creeping or bunch, short or tall, wide of narrow leaves, stemmy or leafy, uniformity, length of growing period, appearance and sales appeal, softer awns, crown width, crown density, etc.

- III. Life Habit:- Annual, biennial, short and long lived perennials, persistence, earliness or lateness, geographic adaptation, day-length, type of reproduction as self, cross, apomictic or vegetative, winter hardiness, summer tolerance, drought tolerance, tolerance to wet conditions, poor drainage, low fertility, high or low pH, salinity, low potash, low phosphate, etc.
- IV. Ease of Establishment - Germination, hard and soft seeds, seedling vigor, seed size, competitive ability of seedlings, ability to store and ship, e.g., rhizomes, tubers, etc.
- V. Genetic Pest Control - Resistance or tolerance to insects and mites, e.g., aphids, spiders, cut worms, army worms, chinch bugs, grasshoppers, lygus bugs, thrips, seed weevils, etc. Resistance or tolerance to plant diseases, e.g., wilts, mildews, anthracnose, black stem, leaf spots, rust, smut, ergot, net blotch, viruses, Helminthosporium, bacterial leaf spots, sclerotinium, blind seed disease, etc. Resistance to other predators: pocket gophers, nematodes, rats, mice, rabbits, cattle and other livestock.
- VI. Seeding Habits - Greater seed production capacity, pollination control, (easier tripping by honey bees), nectar production, control of seed diseases, less shattering, higher seed set, resistance to adverse climate at blooming time, cytogenetic stability and balance, stature of plant for harvesting purpose, uniformity of height and maturity, seed easier to harvest, less chaff, more easily threshed and cleaned, a distinctive color or other character for use in roguing.

From the above list of items (which is necessarily incomplete) it is quite evident that the forage crop breeder is faced with a large number of items for or against which to select. It is manifestly impossible to work on all items independently. Some type of procedure is required which will take into account many characters at one time. The best and to date most successful method is the time-tested method now in general use and which has been used by all men involved in crop improvement from stone age times - just pick the good ones. The good plants must of necessity be reasonably well adapted to the site, the conditions, the climate, etc., and reasonably resistant or tolerant to the common diseases and insect pests, etc. Such plants may never rate the highest in any one category but they must be fairly well adjusted to the complex of factors operating on the selection nursery.

Let us not forget that over 90 percent of the progress in plant breeding was made long before the science of genetics was established. It has been stated that not a single staple crop has been added to the human diet since the stone age. Everyone of the great crops upon which our civilizations have been based were domesticated and improved by stone age men. And how was this accomplished? By picking the good ones. The process is still going on by men who are not far removed from stone age cultures, men who can neither read nor write and who have never heard of

genes or chromosomes. I have seen the process myself in Turkey where I met and talked with a peasant farmer in a remote section of the eastern mountains. He had collected seed of wild sainfoin from the mountainsides near his home, established a plot in his garden, selected the better hay types and had developed one of the best forage varieties we saw on the entire expedition. This man's way of living was not far removed from the stone age but he had a sensitivity and feeling for plants of a high order. He maintained his existence by growing plants; they were his life-work, and he knew the plants of his fields as a plant breeder knows the plants in his nursery.

Other selection indices may be summarized as follows:

- A. Empirical measurements: Dry matter, protein, minerals, sugars, etc., measurements of intake by livestock and letting the livestock make selections.
- B. Subjective scoring or rating: Scoring systems of 1 to 9, 1 to 5, 0 to 10, etc., are used for many characters. Although subjective, such ratings are often quite accurate; the errors may in fact be no greater than in empirical measurements.
- C. Compound systems: Edgar Anderson's whiskers is one example (See his Plants, Life and Man). This method permits one to develop patterns in complex populations by the use of several characters at one time. May have special use in interspecific populations, etc. A second very useful method is to set up continuous classes using several characters at once and rating plants by number (See Harlan 1950, Agron. Jour.). Finally, ratios are often much more useful than straight measurements. By relating one part or one measurement to another data sometime make sense when they mean nothing whatever as independent characters.

The use of a selection index is like the choice of a breeding system. The best one is the simplest one that works.

10:55 A.M. Forage Crop Seed Production - E. A. Hollowell, Division
Forage Crops & Diseases, BPISAE, USDA, Beltsville, Md.

Panel Discussion: Fertility, Modes of Pollination and Cultural Practices Affecting Seed Production, P. B. Gibson, Ala. Agric. Expt. Station; Insects as Related to Seed Production, F. W. Poos, Bu. Ent. & Plt. Quar., USDA, Beltsville, Md.; Harvesting & Processing Seed, E. G. McKibben, Bu. Ent. & Plt. Quar., USDA, Beltsville, Md.; Increasing Seed Stocks of Superior Varieties, C. S. Garrison, Div. of Forage Crops & Diseases, USDA, Beltsville, Md.

Abstracts of the material presented are as follows:

In establishing a good pasture nothing is of more importance than that of a satisfactory supply of superior seed. The seed situation is becoming more important with the development of improved strains of the grasses and legumes. Maintaining the price of these seed at a reasonable level is a must for farmer acceptance. High and efficient seed production year in and year out combined with honest and efficient merchandising are essential to a satisfactory seed supply.

Initiation of seed formation is the first step in a production program. This part of the discussion concerns the initiation of seed and the factors affecting this process.

Seed of a plant may arise from an asexual ^{or a sexual} process involving seed formation. Unreduced parthenogenesis in which an unfertilized egg develops with the diploid chromosome number is probably the most important type of apomixis concerning agronomists.

Apomixis is important to the plant breeder since reduction, segregation and recombination do not occur in this process. Apomixis occurs only occasionally in some plants, but in certain species it has become habitual. It occurs in the genus Paspalum. Dallis grass and certain Bahia grasses are involved.

Pollinating agencies are not often important in the seed production of these crops. Other than this exception the factors affecting seed production of these crops are generally the same as for the crops that produce seed by the usual sexual process.

The sexual process involves: reductional division, formation of gametes, pollination, fertilization and development of the embryo and other seed parts. Satisfactory completion of each of these steps is essential for the formation of a seed.

Any factor which affects one or more of these steps influences the setting of seed. Some of the important factors which may thus influence seed production are:

1. Fertility and flowering habits of the plant, e.g., self-incompatibility and male sterility.
2. Climatic, including wind, temperature, humidity, rain and light.
3. Soil, including fertility and moisture.
4. Pests, including insects and diseases.
5. Management, including time, rate and method of planting, companion crops, cultivation, grazing, burning and mowing.
6. Pollinating agencies for cross-pollinated crops.

A discussion of each of these factors and the interactions of these factors would consume too much time. We shall conclude this discussion with examples of the importance of a few of these factors.

1. Satisfactory yields of the Oregon strains of Ladino white clover cannot be produced in the South apparently because of our shorter hours of daylight.
2. Low temperatures occurring while crimson clover was in blossom caused reduced yields this year in parts of Alabama.
3. Rain accompanied by warm weather usually results in low yields of vetch seed. Apparently, the explanation is an interaction of the vetch plant, temperature, humidity and disease.
4. In general, applications of nitrogen are necessary for the production of grass seed. Results of studies with tall fescue conducted in North Carolina indicate the importance of rate and time of applying nitrogen.
5. Applications of five pounds of borax per acre increased the yield of crimson clover at Newton, Mississippi, from 81 to 197 pounds per acre. Comparable increases have been obtained on boron deficient soils in other states - in some cases greater increases have been obtained.
6. Many other examples could be presented.

Developments in seed production have largely been based on the practical experiences of growers and technical advisors. Research concerning seed production in the future will of necessity become increasingly detailed. To prove of maximum value it will need to enter more and more into the field of fundamental research. Observing and recording factual data often proves to be of wide practical interest and is frequently adequate in the early phases of new investigations. Results of great value can be obtained quickly in this way and will serve to solve many an immediate problem. To know the ultimate reason why the observed response takes place is likely to be more difficult and more time consuming. It is by the combination of "know how" and "know why" that real progress will be made. An inventory of cytological, physiological and life history studies of our grasses and clovers will indicate the need for such studies. Doctor Hollowell is responsible for the initiation of such studies on crimson clover. Other similar tests are in progress, e.g., lespedeza work in North Carolina. Let's hope many more will be initiated.

Insects as Related to Seed Production - E. V. Roos, Bu. of Entomology and Plant Quarantine, USDA, Beltsville, Md.

A national survey of the forage leume and grass insect problems was conducted by Mr. B. A. App of this Bureau last winter. Entomologists and others in 44 states, including all of those represented at this Conference, were interviewed. The insects considered of major importance in the South and the number of states so reporting them, were as follows: Pea aphid, 11; fall armyworm, 9; three-cornered alfalfa hopper, 7; corn earworm on soybeans, 7; potato leafhopper, 6; lesser clover leaf weevil, 6; vetch bruchid, 6; armyworm, 5; velvetbean caterpillar, 5; and southern corn rootworm, 5.

The following were reported of major importance less frequently: White grubs, 4; green June beetle, 4; thrips, 4; meadow spittlebug, 4; webworms, 3; green clover worm, 3; clover root curculio, 3; lygus bugs, 3; clover seed chalcid, 2; cutworms, 2; wireworms, 2; mites, 1; and alfalfa weevil, 1.

Other injurious species in the South on which research is now being conducted include the Rhodes-grass scale, sweetclover borer, lupine maggot and lupine weevil (Sitona explicita Casey).

Much progress has been made in recent years in controlling several of the injurious insects attacking forage crops in the South but a great deal more research is needed before we have the answers we need to many of our problems. A few of these will be discussed briefly. The three-cornered alfalfa hopper damages alfalfa and lespedeza by sucking the juices and girdling the base of the plant just above the crown. This injury stunts the growth and is an important factor in lowering the quality and quantity of the hay produced in addition to shortening the life of stands. Only limited tests with insecticides have been conducted for the control of this insect, but apparently it is not an easy one to control by means of any of the new insecticides tested thus far.

Another insect that is of considerable importance at times in the production of seed crops of clover in the South is the clover seed chalcid found wherever attempts are made to produce seed. Thus far no effective insecticidal control has been discovered. Cultural control for this insect as well as for the three-cornered alfalfa hopper has been only partially effective.

With the increased use of Ladino clover in the Southeast, the green June beetle has become very destructive to this crop. The injury is not caused by direct feeding on the plants, but when the larvae are sufficiently abundant they loosen the upper 3 inches of the soil by their burrowing to such an extent that not only the young seedlings cannot survive but old stands are destroyed within a period of 3 years unless control measures are applied. Research on the control of this insect with insecticides has given promising results. Comparatively small dosages of aldrin are very effective if the applications are made at the time the eggs hatch or within a few weeks thereafter. The larger grubs are much harder to kill. Further research is necessary to determine the best methods and time of application of preventive insecticides against this insect. It seems probable that such applications can be made to fit into a normal pasture management program.

Of much concern at this time is the alfalfa weevil which was first reported in Maryland in 1952 although it has been a serious pest of alfalfa in the West for nearly 50 years. It was found in Maryland, Delaware, Virginia, Pennsylvania and New Jersey in that order during 1952, with only a few fields noticeably damaged. The mild winter of 1952-53 apparently had no adverse effect on this insect in the eastern area of its distribution because a larger number of fields were much more severely damaged in Maryland and Delaware in 1953 than during 1952, further emphasizing the potential importance of this insect in the East. Control with a single application of insecticides is effective in the West, but preliminary tests in Maryland during 1953 indicate that a single application may not give adequate protection. Damage to alfalfa by this

insect is much more severe in mixed stands and this may discourage their use in the East, especially if the severity of attack by this insect continues to increase.

Beneficial Insects - In recent years more and more attention has been paid to the importance of beneficial insects in the production of seed of forage legume crops. Greatly increased yields (194 to 361 pounds per acre) of vetch were reported in 1950 by Thomas where colonies of honey bees were placed near fields for pollination in Texas. Amos (1951) reported a 250 percent increase in crimson clover seed in Tennessee over a 3-year period in the presence of honey bees as compared with no honey bees being present. The favorable effect of honey bees on the pollination of crimson clover, red clover and sweetclover was reported by Killinger and Haynie in Florida (1952). Weaver and Ford (1953) reported that crimson clover in Texas with adequate numbers of honey bees yielded about 4 times as many seed as clover with no honey bees. Work is also in progress in Mississippi by Mr. H. B. Green on the pollination of white Dutch clover by honey bees. His work indicates (personal communication) that honey bees have a very beneficial effect on increasing the yield of white Dutch clover seed. Federal and State workers in Utah, California and Arizona have contributed much to our knowledge of the value of honey bees in the production of alfalfa seed. Much remains to be learned about the placement of the colonies and the exact number required per acre under the various conditions involved, but it is an encouraging trend that seed yields are being increased by increasing the number of pollinators at the opportune time.

Harvesting and Processing Seed - E. B. McKibben, EPISAE, USDA,
Beltsville, Md.

According to Dr. McKibben, losses in harvesting forage seed crops are very large. There are many problems connected with harvesting of forage seed due in part to the large number of forage species being grown for seed. It is a case of adapting machines to specific crops in favorable seed producing areas. Even under good conditions and with some of the older crops, seed losses are too high. For example, reports from Kansas show losses of 36 percent of alfalfa seed. In some areas seed production has declined and growers are going out of the seed business due to serious seed losses in combining the crop.

Breeding to develop better harvesting types would undoubtedly aid in the solution of the problem. Resistance to lodging and seed shattering are most important. Even with better varieties the operation of the combine requires a skilled operator. Because of the diversity of forage crops for seed production, the kind and type of experience gained by any farmer will be limited.

Many types of harvesting machinery, combines, strippers, vacuum harvesters and special windrowers have been developed and work is under way to develop better harvesting methods to secure maximum seed yields.

California is doing considerable work, particularly on harvesting small-seeded grasses and legumes. Workers in Canada, Oregon, Kansas and many other western states are also concerned with developing better methods of harvesting forage seed crops.

Even with better machines it is possible that we may not know the proper time of harvest to secure maximum yields of high quality seed. The stage of maturity is extremely important, and with many crops earlier seed harvests may result in maximum yields of quality seeds. The timeliness of the seed harvesting operation is all-important with certain crops. The California Station is evaluating various defoliant in their seed production studies. Their tests are interesting and the use of certain defoliant result in more uniform drying and greater seed yields.

Dr. McKibben, in closing, pointed out the need for additional studies with regard to combine adjustments, cylinder speeds, sieve openings, etc. In general, slower cylinder speeds have resulted in less damaged seed, while higher speeds are possible in dry areas.

Increasing Seed Stocks of Superior Varieties - C. S. Garrison, Div. of Forage Crops & Diseases, EPISAE, USDA, Beltsville, Md.

Certified seed of a number of improved forage crop varieties is now available in volume for distribution to the consuming areas by the Seed Trade. The build-up of this seed supply has occurred within the past three years. Prior to 1950, the annual supply of seed was so small and undependable that the seed trade and the Extension Services were unable to plan for its distribution and usage.

Accomplishments in building forage seed supplies has resulted in a large measure from the efforts of the Foundation Seed Project through the cooperating State experiment stations, extension services, seed certifying agencies, Seed Trade, State foundation seed organizations and the USDA. Thirty-six State Experiment Stations are cooperating with the project under signed Memoranda of Understanding.

The change in the supply picture is best shown by comparison between the amount of certified seed produced in 1953 and that available in 1949, the year the Foundation Seed Project got underway.

The Production of Certified Seed of Several Improved Forage Crop Varieties

Variety	Certified Seed Production	
	1949(lbs.)	1953(est.)(lbs.)
Atlantic Alfalfa	14,568	2,500,000
Buffalo "	324,300	8,000,000
Narragansett "	-	125,000
Ranger "	1,101,235	33,000,000
Kenland Red Clover	37,445	2,000,000
Tift Sudangrass	-	150,000
Climax Lespedeza	-	10,000

The 1953 production of certified Atlantic, Buffalo, Narragansett and Ranger alfalfa seed is adequate to plant nearly 40 percent of the alfalfa acreage in 1954 in the northern and central regions. Stock seed of these varieties has been built up so that the production of certified seed can be increased as the demand warrants. For example, the amount of certified Narragansett seed could be two and one-half million pounds by the fall of 1954. The actual amount produced by seed growers in the West will depend on the estimated need by the Seed Trade and the experiment stations in the consuming areas.

The progress in building seed supplies of Vernal alfalfa under the Foundation Seed Project's auspices indicates how the time has been shortened between the release of a new variety by an experiment station and availability of seed to the consuming farmer. Vernal was approved by the Planning Conference of the Foundation Seed Project in February 1953. Foundation seed fields were established in Utah and Washington in April. At the same time, 10 pounds of stock seed were planted in California for certified seed production. The score, following harvest this past fall, was: 7,800 pounds of foundation Vernal from the 31-acre field in Wash. and 6,400 pounds of certified seed from California. The Foundation Seed Project, working with the other cooperating groups, can make possible the production of more than 3 million pounds of certified seed for planting in 1955 if consumer demand warrants this rapid an increase. This is quite different from the story for Atlantic alfalfa. Eight years after its release only 14,568 pounds of seed were produced.

Two foundation Pennscott red clover fields were started in the spring of 1953. Six months later a seed crop was harvested from both - one averaging over 500 pounds per acre. As a result of this seedling year production, large quantities of certified Pennscott seed will be available to northeastern farmers after 2 or 3 more growing seasons.

The speed at which the certified seed supply of new varieties is increased is determined by consumer demand. Intensive educational and promotional programs by the extension services and seedsmen are essential if farmers are to accept new strains as rapidly as it can be made available.

Funds have not been available to initiate work on the second phase of the Foundation Seed Project: "Seed Service to Insure Varietal Identity". However, some progress has been made with the alfalfas and Kenland red clover. Through the cooperation of the seed producing and seed consuming states, tests have been arranged to check the genetic quality of lots of Atlantic, Buffalo, Ranger and Kenland grown in the different areas. Tests are under way at 14 different locations for the 3 alfalfa varieties and at 8 locations for Kenland red clover.

Seed production problems are beginning to arise in certain of the new areas in the West. Special attention by research is needed to solve these problems in order that forage seed production may be expanded and maintained. The past history in older areas has been a thriving forage seed business for a few years followed by a decline in production because of insects, diseases and other problems which make seed growing an unprofitable farm enterprise.

11:45 A.M. Lunch.

Afternoon Session, June 12, 1953.

General Meeting - R. C. Potts, Chairman.

Dr. Potts called the meeting to order. The program proceeded as planned.

1:15 P.M. *Recent Advances in Livestock Breeding with Respect to Forage Utilization - C. M. Kincaid, Va. Agric. Expt. Station.

Breeding research with beef cattle at several experiment stations is presently directed toward the development of methods of measuring performance with pasture alone or with rations containing a high proportion of forage. Satisfactory liveweight gain and fatness of yearling cattle have obtained with rations in which hay or silage furnish 40 percent or more of the total feed. A.R.O.P. test ration for bulls and steers at the Virginia Station, made up of 40 percent ground hay, 50 percent ground ear corn, and 10 percent oil meal has shown average daily gains from weaning to 15 months of age, of approximately two pounds per day. Studies of inheritance of growth rate with steers fed in dry lot on the above test ration and with their half sib heifers fed on pasture alone, show somewhat the same relative order for progenies for different sires.

The measurement of performance on a basis for selection of breeding animals is similar to pasture comparisons with grazing animals in that prior treatment has much influence on results obtained during a test period of a few months. Data from wintering and grazing tests at the Virginia Station over a 10-year period show an inverse relation between gains during the winter and subsequent gains from pasture. On the average, summer gains were decreased by about 60 percent of the winter gain with the result that annual net gain was increased about 40 percent of the winter gain. Yearling and 2-year-old steers with equal winter gains made approximately the same summer gains if the pasturage was good, but 2-year-olds made smaller gains in unfavorable years. Steers wintered at maintenance have shown average gains of 2.0 pounds per day while those wintered to gain 1.0 pounds per day showed gains of 1.4 pounds per day, approximately. Increase in liveweight gain from extra feed in winter, on the average, increased carcass weight by an amount equal to the increase in liveweight. An increase in total annual gain of 50 pounds improved the slaughter grade by from 1/3 to 1/2 of a grade, and at present prices, amounted to \$25.00 per head. In pasture experiments, gain per acre of pasture may mean very little unless previous history of the animals is taken into account. In these experiments, the increased weight and value of the carcass has usually amounted to more than the value of extra feed added to a maintenance ration for gains in the winter prior to fattening on pasture. A comparison of different rates of grazing indicated that heavy grazing showed the greatest beef gains per acre of pasture, but lowered returns per acre of pasture (as compared with intermediate or light grazing) due to a longer winter feeding period and lower final market value of the whole steer. Stocking

rates which insured an abundance of feed at all times in the grazing season, was most profitable on the basis of production from birth to marketing. A study of offal weight (all non-carass tissue) at various ages, indicated that dressing percentages of 18, 30 and 42-month-old steers required liveweights of 900, 1160 and 1300 pounds, respectively. When wintered at gains of approximately 1.0 pounds per day and grazed on pasture alone for 6 months, 18-month-old steers failed to achieve their standard, but 30 and 42-month-old steers did. It appears that satisfactory pasture fattened steers (yield of 55 percent or better) may not be possible with animals under 2 years of age.

1:45 P.M. The Program of the Division of Forage Crops and Diseases -
D. F. Beard, Head Agronomist in Charge, Div. of Forage
Crops & Diseases, EPISAE, USDA, Beltsville, Md.

- Attention was called to the potential of grasslands in the Southeastern States where 70 million acres of improved pasture could be developed with benefit to the entire agriculture of the Southeast. The output from this grassland could well exceed the total beef production in the entire United States at the present time. The increasing trend toward beef production in the area indicates to some degree that the grassland potential of the area is beginning to be recognized by farmers as well as by others.

Although grasslands occupy more of the Nation's land area than all other crops combined, the total support for research in the Division of Forage Crops and Diseases falls far short of needs. Our Division is one of the few in the Bureau of Plant Industry, Soils, and Agricultural Engineering that deals with crops important in every state of the Union. The need for applied research has been so obvious and demanding that we have been unable to do the amount of fundamental work that should have been done on the genetics, breeding techniques and management of the many forage grasses and legumes. For example, the pressure has been and still is on to determine cheaper and more certain methods of establishing grassland crops. Cooperative work has been expanded during the past year with the agricultural engineers and soils and fertilizer workers to solve this problem in the Southeast. With few other crops have farmers accepted failure so regularly as with the forage grasses and legumes. Failure of establishment is one of the principal costs of establishment, not only because seed and seed bed preparation expenses are wasted when stands fail to establish, but also because needed expected forage fails to materialize and more expensive substitutes are required for feed.

You may be interested in some of the early findings that have come out of this work. One of the most significant, I think, is that proper seeding methods and placement of fertilizer with seed has given very satisfactory stands of fescue and Ladino clover at Beltsville with half the amount of seed customarily used. In fact, 1/4 of the normal rate gave stands that would be acceptable to most farmers.

The placement of fertilizer with respect to seed had a noticeable influence in rate of establishment, survival of seedlings, amount of growth and the control of weeds. Placing the fertilizer in a band directly below and one inch lower than the seed appeared to be one of the best, if not the best placement for a variety of rates of fertilizer applications. For example, at moderate rates of application (250 and 500 pounds per acre of 3-12-6) the effect of such placement as compared with the same rate and method except that the fertilizer was offset one inch to the side made a difference of approximately 35 percent in the first cutting of mixed Ladino-fescue this past spring. Broadcasting of the seed or fertilizer or both was an open invitation to weeds and in some replications the weeds nearly smothered the fescue and Ladino. This work is being handled in one of the 7 major projects of the Division under the leadership of Mason Hein and Bob Wagner. Within the same project is done all of the pasture and range work as well as a culture and management investigation.

The other six projects are alfalfa production, breeding, disease, and quality investigations under the leadership of Dr. Fugo Graumann, clover production, breeding, disease, and quality investigations under the leadership of Dr. E. A. Hollowell, soybean investigations under the leadership of Dr. M. G. Weiss; lespedeza, lotus, lupine and other southern legume production, breeding, and disease investigations under the leadership of Paul R. Henson, turf investigations under the leadership of Dr. J. C. Harper, and grass breeding investigations under the leadership of Dr. A. A. Hanson. The work on grass used to be combined with the pasture management research but has recently been separated from it (At this time the new project leader was introduced to the group and asked to comment upon the grass improvement program).

X Coordination of Regional Grass Improvement Programs - A. A. Hanson, /

The organization of the Regional Forage Crops Technical Committees has added impetus to cooperative research in the 4 major regions. As these committees are concerned with the entire field of forage crop improvement, we as grass breeders, cannot expect them to exhaust all possibilities for needed regional and interregional research. Thus, it would seem reasonable to examine in some detail the possibilities for furthering cooperative research. The uniform variety testing program provides a good opportunity to obtain information on the region of adaptation of some of the grass varieties. One can hope that agreement can eventually be reached regarding the value of varieties included in this program. If this is not too optimistic a view one can envision the possibility of reducing the number of varieties which should be multiplied for distribution, thus insuring that the farmer can obtain seed of a good variety in the interim during which new varieties are being developed. In addition, the better varieties as determined by these tests would serve as logical checks in tests designed to compare new strains or synthetic varieties. Perhaps the greatest value of these uniform tests will be their role in evaluating new varieties prior to release. Thus, it should be possible for originating stations to obtain a picture of the variety's area of adaptation and at the same time other locations would have sufficient information to develop their own recommendations.

2:10 P.M. Report on the Cooperation Between Southern Pasture Men and the Primary Plant Introduction Station - Edwin James, Coordinator, EPISAE and Ga. Agric. Expt. Station, Experiment, Ga.

During the initial work in setting up the New Crops Program for the Southern States it was indicated by questionnaire that introduction of forage crops should have top priority. As a result, a large number of grasses and legumes have been introduced. Catalogs of these introductions have been distributed in the Southern States and if correct procedures have been followed they should have reached all forage crops men in the South.

Only a few of these introductions appear to have some value and these have not received very wide distribution. This may be due in part through lack of emphasis on the part of the coordinator and a remedy is being sought to subject promising introductions to further tests.

It is not the intent of this program to supplant the existing cooperative program between State men and the Bureau. It is proposed, however, that a supplement to each forage crops catalog be put in the hands of those who participate in the uniform nursery program so that the possibilities of such introductions can be thoroughly checked. It is felt that 2 or 3 accessions a year would not be a burden and may result in the development of a promising new forage crop.

2:15 P.M. Business Meeting, R. C. Potts, Chairman.

Dr. Potts announced that the Executive Committee had elected Dr. J. K. Leasure of Tennessee, as Chairman for the coming year. The Chairman called for nominations to elect the new member of the Executive Committee. Dr. D. S. Chamblee was nominated and unanimously elected. The Executive Committee for the coming year is as follows:

T. H. Rogers, Georgia	1954
R. C. Potts, Texas	1955
J. K. Leasure, Tennessee	1956, Chairman
P. C. Sandal, Arkansas	1957
D. S. Chamblee, N. Carolina	1958
R. H. Lush, Tennessee, Dairy Husbandry	
H. F. Leveck, Mississippi, Animal Husbandry	
F. R. Henson, Permanent Secretary	

In opening the topic as to a meeting place for next year, the Chairman read the following invitation from Dr. Jones of the Oklahoma Agricultural Experiment Station:

"Dr. Jack Harlan of our Agronomy Department has indicated that he has discussed with you the matter of a joint meeting of the Southern and Western Conferences here at Oklahoma A. and M. College in 1954. On behalf of the College administration, I should like to extend to you an official invitation to meet on this campus.

"I believe you would find the facilities here adequate to accommodate the needs of the group and it would be a genuine pleasure to entertain the Conference. Dr. Harlan will be happy to assist in arranging dates which would fit into the schedule of our activities."

The desirability of a joint meeting with the Western Grass Breeders was favorably discussed. Dr. Burton (Ga.) moved that the invitation from Oklahoma be accepted. The motion was seconded and passed unanimously. Dr. Fergus (Ky.) moved the Secretary be instructed to write a letter of appreciation to Director Young of the Virginia Agricultural Experiment Station for the excellent arrangements and facilities for this Tenth Conference. There being no further business, the Conference was adjourned for the field trip.

3:20 P.M. Field Tour - R. E. Blaser, Leader, Va. Agric. Expt. Station.

The group was divided for each of the field trips. The first afternoon, half of the group toured the fertility and management pastures while the other group was observing the breeding and small plot studies. The second afternoon the tours of the groups were reversed so that all had an opportunity of seeing forage crop work under way at Blacksburg.

Summary of Field Trip on Pasture Fertility, Management, Mixture and Trefoil Experiments - R. E. Blaser, H. L. Dunton and others.

1. Birdsfoot trefoil. Three varieties of birdsfoot trefoil and big trefoil were grown with different grass mixtures. Big trefoil was not adapted. Italian birdsfoot trefoil has produced better stands and yields than Empire trefoil. Best stands and growth of the trefoils are associated with light sowing rates of the associated grasses and legumes. Stands are better with slow growing species.
2. Mixture experiments. Grass-legume mixtures are studied under different management practices to simulate silage, hay and grazing-cutting practices. Results show that alfalfa-grass mixtures are more productive than any other grass-legume combinations. Ladino clover-orchardgrass mixtures were very unproductive during dry years.
3. Cutting-management experiment with fescue-Ladino and orchardgrass-Ladino clover mixtures. A new experiment in which yields and botanical composition are being measured as influenced by height when cut and closeness of cutting to the ground and by grass seeding rate.
4. Five fertility experiments with forage crops were visited.
 1. Rates and frequency of applying P_2O_5 and K_2O to orchardgrass-alfalfa and Ladino clover-alfalfa mixtures.
 2. Residual effect of fertilizers when all herbage is removed, part removed, and with no herbage removed.
 3. Relative effects of stage of growth and fertilization on the chemical composition of 3 mixtures.
 4. Effect of nitrogen fertilization on the seasonal growth curve.
 5. Effect of potassium and nitrogen fertilization on the botanical composition and yields of individual species and mixtures.

The latter experiment was probably the most interesting one which showed that the legume stand was lost with nitrogen fertilization in the absence of potassium fertilization. When potassium was added to the nitrogen it was possible to maintain the legume. Grasses absorbed more potassium than the legume. By applying nitrogen which stimulated grass, the potassium shortage for the legume in the soil was augmented.

Forage Breeding - T. J. Smith. The orchardgrass source nursery and breeding block showing growth type, differences in disease resistance and time of maturity was observed. Other phases included strain tests with alfalfa, tall fescue, bromegrass and orchardgrass.

Irrigation Experiment with Mixtures - H. L. Dunton. Fifteen mixtures of grasses and legumes are being measured for total and seasonal production with and without irrigation. In addition to this one of the mixtures receives 3 levels of nitrogen fertilizer during the summer months to study its effect on augmenting summer feed supply. To justify supplementary water, productive mixtures must be used. This experiment should isolate the mixtures which might be suitable for high production under irrigation.

Beef Cattle Grazing Experiment. In this experiment the quality and quantity of production of a bluegrass-white clover and a Ladino clover-orchard grass mixture is being evaluated with steers. Each of the mixtures is being tested with and without irrigation in two replications. The 1952 results showed that the quality of the herbage was improved by irrigating for 2-year-old steers, but had no effect on 1-year-old steers. The carrying capacity was increased substantially by supplementary water in 1952. In the previous 2 years before orchardgrass-Ladino clover was added to that experiment there were only slight growth responses from irrigation with the bluegrass-white clover mixture.

Dairy Experimental Pastures - W. A. Hardison. General lay-out of experimental pasture plots was given. Experimental results (in terms of lbs. TDN and lbs. 4 percent FCM per acre) secured during last 3 years were presented in mimeograph form. Current pasture research including renovation and irrigation of pasture, grain feeding to cows on pasture, nutritive value of pasture herbage under grazing conditions, and grazing behavior of dairy cattle was discussed.

Summary statements on the engineering phases of the cooperative Supplemental Irrigation Project were given during the field trip by members of the Agricultural Engineering Department as follows:

1. Irrigation of selected field and forage crops using 1/20-acre test plots - J. Nick Jones.

Corn, small grain, red clover, burley tobacco and alfalfa have been under irrigation tests 4 years. Results were inconclusive. Rainfall during 2 of the 4 years was high and well distributed throughout the season. In 1951 and 1952 total rainfall was about normal but distribution was poor. Except for the corn and burley tobacco plots in the special moisture level study, irrigation was applied when approximately 60 percent of the available soil moisture in the crops' effective root zone was depleted.

Irrigation has given maximum yield increases from corn of about 20 bushels per acre, wheat 6 bushels per acre, and alfalfa slightly over one ton of dry hay. Red clover has shown little response. Burley tobacco yields have been increased as much as 10 percent. On the other hand, because of the sensitivity of tobacco to excess moisture, irrigation has in a few instances actually decreased yields when heavy natural rainfall immediately followed the irrigations. More research is badly needed to establish dependable irrigation procedures to minimize such hazards. The relatively low response of alfalfa to irrigation in these tests is not understood at this time.

2. Pasture species and mixtures irrigation studies - J. Nick Jones.

The engineering participation in this study includes the soil moisture determinations and irrigation operation and management. Water is applied when approximately 60 percent of the available soil moisture to the depth of the effective root zone - considered to be about 1.7 ft. for these crops - has been depleted. Each application is designed to refill the soil to field capacity.

3. Beef animal, pasture irrigation studies - J. H. Lillard.

The engineering participation in this project includes soil moisture studies, irrigation operation and management, equipment studies, costs, etc. The same irrigation procedures as listed above for the Pasture Species and Mixtures Study are followed. Irrigation requirements have varied from 1½ to 7½ inches per year during the past 4 years. Total irrigation costs approximate \$3.00 per net acre inch of water applied on this installation. An electric motor driven centrifugal pump, portable quick coupling pipe and rotating sprinklers are used to apply the water at .4 inch per hour. The sprinklers are spaced 40' x 60' and are operated for 5 hours in each lateral position.

4. Dairy animal pasture irrigation study - J. H. Lillard.

This is the first season for this study. The engineering procedures are the same as on the Beef Animal irrigation study. A gasoline engine-pump unit is used in this system. Otherwise the equipment and procedures are similar to the Beef Animal Study.

Saturday, June 13, 1953

7:00 A.M. Leave for Middleburg, Va.

A good percentage of the group left late Friday evening for Middleburg, Virginia. The group assembled at the Experiment Station office where Dr. Blaser, Mr. Taylor, and others discussed the objectives of the Northern Virginia Pasture Research Station.

The group toured the Station with frequent stops to discuss various experiments.

Beef Cattle Grazing Experiments: Three years' results grazing triplicate pastures of various grass-legume mixtures. Most beef produced on orchardgrass-Ladino and tall fescue-Ladino mixtures. Better seasonal distribution of gains would be obtained by using several mixtures.

Dairy Cattle Pastures: A comparison of management, pasture mixtures and supplementary feed on milk production. Ladino alone was more productive than orchardgrass-Ladino. Milk production was as high on light grain feeding as on medium grain feeding.

A palatability experiment as measured by the amount of total available herbage grazed, was interesting. Orchardgrass-Ladino was most palatable, tall fescue least palatable. Ladino improved the palatability of tall fescue.

Of interest were experiments on cutting management of alfalfa and various mixtures with alfalfa. The rate of establishment tests and the many variety tests of legumes and grasses were of real interest to the group.

REGISTRATION LIST - 1953

<u>Name</u>	<u>Address</u>	<u>Firm Represented</u>
Allen, C. W.	Blacksburg, Va.	Va. Agric. Expt. Station
Amos, John	" "	" " " "
Ayers, T. L.	Washington, D. C.	P.N.A. - USDA
Bates, R. P.	Beltsville, Md.	EPISAT - USDA
Beard, D. F.	" "	" " " "
Bennett, E. W.	State College, Miss.	Miss. Agric. Expt. Station
Blaser, R. E.	Blacksburg, Va.	Va. " " "
Brinkley, R. M.	Raleigh, N. Car.	N. C. " " "
Burn, J. D.	Auburn, Ala.	Ala. " " "
Burns, R. E.	Experiment, Ga.	Ga. " " "
Burton, G. W.	Tifton, Ga.	Coastal Plain " "
Chamblee, D. S.	Raleigh, N. Car.	N.C. Agric. Expt. Station
Chappell, W. E.	Blacksburg, Va.	Va. " " "
Chessmore, R. A.	Ardmore, Okla.	Samuel Roberts Noble Fndn.
Cope, W. A.	Raleigh, N. Car.	N.C. Agric. Expt. Station
Cowart, F. F.	Experiment, Ga.	Ga. " " "
Browder, L. V.	" "	" " " "
Cummings, R. W.	Raleigh, N. Car.	N.C. " " "
Davis, R. E.	Beltsville, Md.	EPISAT, - USDA
DeVane, E. H.	Tifton, Ga.	Coastal Plain Expt. Sta.
Dobson, S. H.	Raleigh, N. Car.	N.C. Agric. Expt. Station
Donnelly, E. D.	Auburn, Ala.	Ala. " " "
Dunton, H. L.	Blacksburg, Va.	Va. " " "
Eheart, J. F.	" "	" " " "
Elder, W. C.	Stillwater, Okla.	Okla. " " "
Elrod, J. M.	Experiment, Ga.	Ga. " " "
Engel, R. W.	Blacksburg, Va.	Va. " " "

Registration List (Cont.)

<u>Name</u>	<u>Address</u>	<u>Firm Represented</u>
Farris, N. F.	Washington, D. C.	Office of Expt. Stations, USDA
Fergus, E. N.	Lexington, Ky.	Agric. Expt. Station
Forbes, Ian	Tifton, Ga.	Coastal Plain Expt. Station
Boneta-Garcia, E.	Rio Piedras, P. Rico	Agric. Expt. Station
Garren, K. H.	Auburn, Ala.	" " "
Gibson, P. B.	" "	" " "
Graf, G. C.	Blacksburg, Va.	Va. Agric. Expt. Station
Graumann, H. O.	Beltsville, Md.	Plant Industry Station, USDA
Hollowell, E. A.	"	" " " "
Hanson, C. H.	Raleigh, N. Car.	N.C. Agric. Expt. Station
Hanson, A. A.	Beltsville, Md.	Plant Industry Station, USDA
Hardeson, W. A.	Blacksburg, Va.	Va. Agric. Expt. Station
Harlan, J. R.	Stillwater, Okla.	Okla. " " "
Henderson, R. G.	Blacksburg, Va.	Va. " " "
Henson, P. R.	Beltsville, Md.	Plant Industry Station, USDA
Hodges, E. M.	Ona, Florida	Range Cattle Station
Holt, E. C.	College Station, Tex.	Tex. Agric. Expt. Station
Hohnso, Paul	Knoxville, Tenn.	Tenn. Valley Authority
Hull, A. C. Jr.	Washington, D. C.	Forest Service, USDA
James, Edwin	Experiment, Ga.	Ga. Agric. Expt. Station
Johnson, H. W.	Stoneville, Miss.	Delta Branch Expt. "
Jones, Nick	Blacksburg, Va.	Va. Agric. " "
Killinger, G. B.	Gainesville, Fla.	Fla. " " "
Kincaid, C. M.	Blacksburg, Va.	Va. " " "
Knight, W. E.	State College, Miss.	Miss. " " "
Kreitlow, K. W.	Beltsville, Md.	Plant Industry Station, USDA
Lacy, M. P.	Blacksburg, Va.	Va. Agric. Expt. Station
Langford, W. R.	Auburn, Ala.	Ala. " " "
Leasure, J. K.	Knoxville, Tenn.	Tenn. " " "
Lewis, W. W.	Blacksburg, Va.	Va. " " "
Lillard, J. H.	" "	" " " "
Lindhahl, I. L.	Beltsville, Md.	Bu. Animal Industry, USDA
Litton, G. W.	Blacksburg, Va.	Va. Agric. Expt. Station
Long, O. H.	Knoxville, Tenn.	Tenn. " " "
Lucas, H. L.	Raleigh, N. Car.	N.C. " " "
Lush, R. H.	Knoxville, Tenn.	Tenn. " " "
Lutz, J. A.	Blacksburg, Va.	Va. " " "
Lynd, J. Q.	Stillwater, Okla.	Okla. " " "
Mann, W. H.	Gretna, Va.	- - -
McCloud, D. E.	Gainesville, Fla.	Fla. " " "
McCullough, M. E.	Experiment, Ga.	Ga. " " "
McGuire, W. S.	State College, Miss.	Miss. " " "
Metzger, R. J.	Clemson, S. Car.	S.C. " " "
Miller, L. I.	Blacksburg, Va.	Va. " " "
Moschler, W. W.	" "	" " " "
Martin, C. M.	Auburn, Ala.	Ala. " " "
Neel, L. R.	Columbia, Tenn.	Southern Agriculturist
Obenshain, S. S.	Blacksburg, Va.	Va. Agric. Expt. Station

Registration List (Cont.)

<u>Name</u>	<u>Address</u>	<u>Firm Represented</u>
Owen, C. R.	Baton Rouge, La.	La. Agric. Expt. Station
Peele, T. C.	Clemson, S. Car.	S.C. " " "
Peterson, R. G.	Raleigh, N. Car.	N.C. " " "
Poos, F. W.	Beltsville, Md.	Fu. Plant Quarantine, USDA
Potts, R. C.	College Station, Tex.	Tex. Agric. Expt. Station
Prince, A. B.	Clemson, S. Car.	S.C. " " "
Reeves, Paul	Blacksburg, Va.	Va. " " "
Reynolds, P. C.	" "	" " " "
Rich, C. I.	" "	" " " "
Ronningen, T. S.	College Park, Md.	Md. " " "
Rogers, H. T.	Auburn, Ala.	Ala. " " "
Sandal, P. C.	Fayetteville, Ark.	Ark. " " "
Sell, O. E.	Experiment, Ga.	Ga. " " "
Shoulders, J. F.	Blacksburg, Va.	Va. " " "
Shulkcum, Edward	" "	" " " "
Shuts, T. J.	Raleigh, N. Car.	N.C. " " "
Smart, W. W. Jr.	" "	" " " "
Smith, T. J.	Blacksburg, Va.	Va. " " "
Stabler, S. P.	College Park, Md.	University of Maryland
Starling, T. M.	Blacksburg, Va.	Va. Agric. Expt. Station
Stewart, E. H.	Clemson, S. Car.	S.C. " " "
Stivers, R. K.	Blacksburg, Va.	Va. " " "
Suman, R. H.	Tifton, Ga.	Coastal Plain Expt. Station
Tabor, Paul	Spartanburg, S. C.	Soil Conservation Service
Tisdale, S. L.	Knoxville, Tenn.	Tenn. Agric. Expt. Station
Tramel, Jim	Blacksburg, Va.	Va. " " "
Turner, J. R.	Auburn, Ala.	Pacific Coast Borax Company
Uribe, Herman	Raleigh, N. Car.	N.C. Agric. Expt. Station
Wise, L. N.	State College, Miss.	Miss. " " "
Yarbrough, J. F.	Nashville, Tenn.	- - -

